

Report 2

Comparison of Postal Service Productivity Measurement: Before and After PAEA Enactment

Final Report

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I. Executive Summary

Northwest Postal Consulting (NWPC) is tasked with performing a two-part review of the U.S. Postal Service's Total Factor Productivity (TFP) measurement. Report 1, Adequacy of the Postal Service's TFP Model, provided a detailed review of the methodology used to calculate TFP.

This report, Report 2, examines the impact of PAEA on productivity (TFP) in the Before and After PAEA periods. The examination focuses on the impact of Underlying, Exogenous, and Pricing factors, particularly the price cap, on Postal Service productivity. The primary tool used in this analysis is the NWPC TFP Model. This model was developed to support the detailed analysis of the TFP components and the creation of new index measurements using the TFP methodology.

The focus of the analysis is on two periods: 1990 to 2006 for the Before period and 2007 – 2016 for the After period. These periods are further segmented into shorter time frames that have their own distinctive TFP trends. NWPC examines the effects of Exogenous, Underlying and Pricing factors on TFP during these periods. As part of that review, Report 2 defines these factors and provides appropriate timelines for each of them. It then shows what role these factors played in influencing the TFP and its underlying components during the defined TFP time segments.

The Before and After PAEA productivity analysis examines the following aspects of the TFP methodology:

1. The impact of labor changes on productivity, including the increase in non-career employee use, is examined.
2. The impact of changes in mail mix due to Underlying, Exogenous, and Pricing factors are evaluated.
3. Postal Inflation trends are mapped throughout the TFP timelines and are compared against CPI-U.
4. Alternative productivity measurements using TFP components are created and analyzed.
5. The Postal Service's focus on delivery indicators, particularly deliveries per hour, is analyzed using the TFP data set.
6. The impact of the weighting factor that combines mail volume, special services, and possible deliveries is identified as a central issue in evaluating productivity in the After PAEA period. An alternative methodology that uses the yearly CRA for the weighting is examined.
7. The Labor, Materials, and Mail Volume components are isolated to identify the role of the Underlying, Exogenous, and Pricing factors on the productivity result. This includes the creation of new indexes to examine specific factors and aspects of productivity.

The analysis resets the TFP results to a new base year of 1990. Figure 1 shows the Workload, Input, and Resulting TFP with 1990 as the base year. Figure 2 shows the combination of the components of TFP with alternative productivity measurements for comparison.

Figure 1: U.S. Postal Service Total Factor Productivity – 1963 to 2016

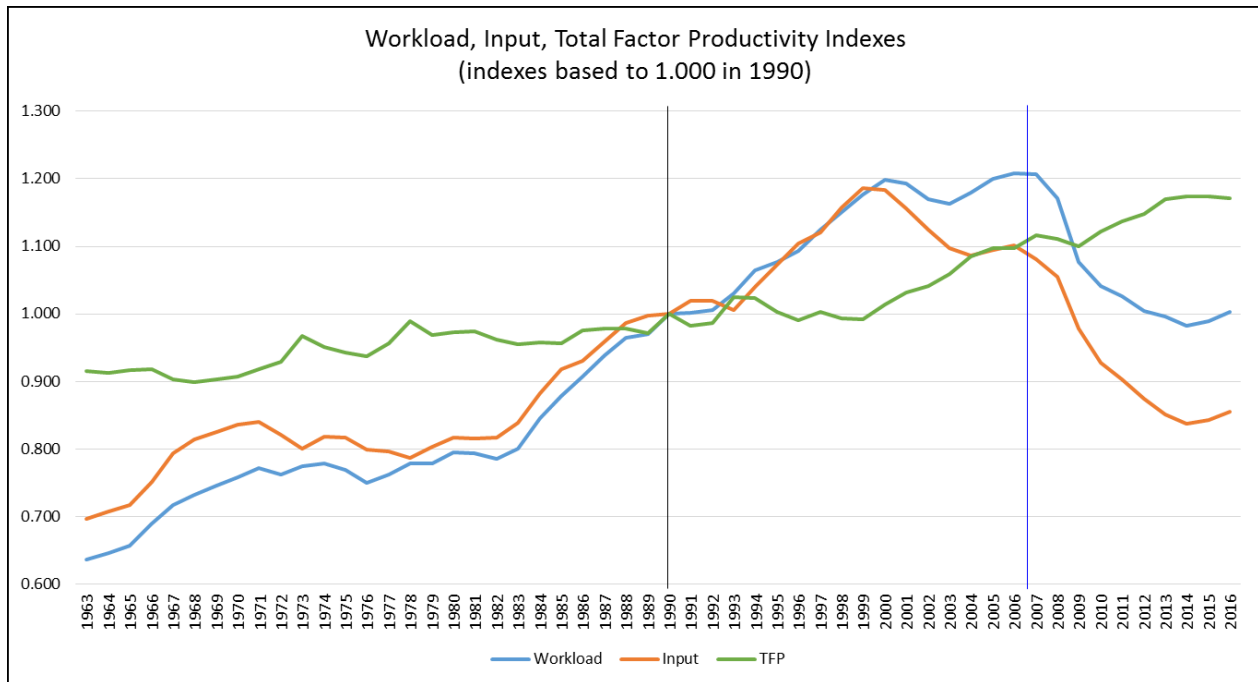


Figure 2: Alternative Productivity Measurements Using TFP Components

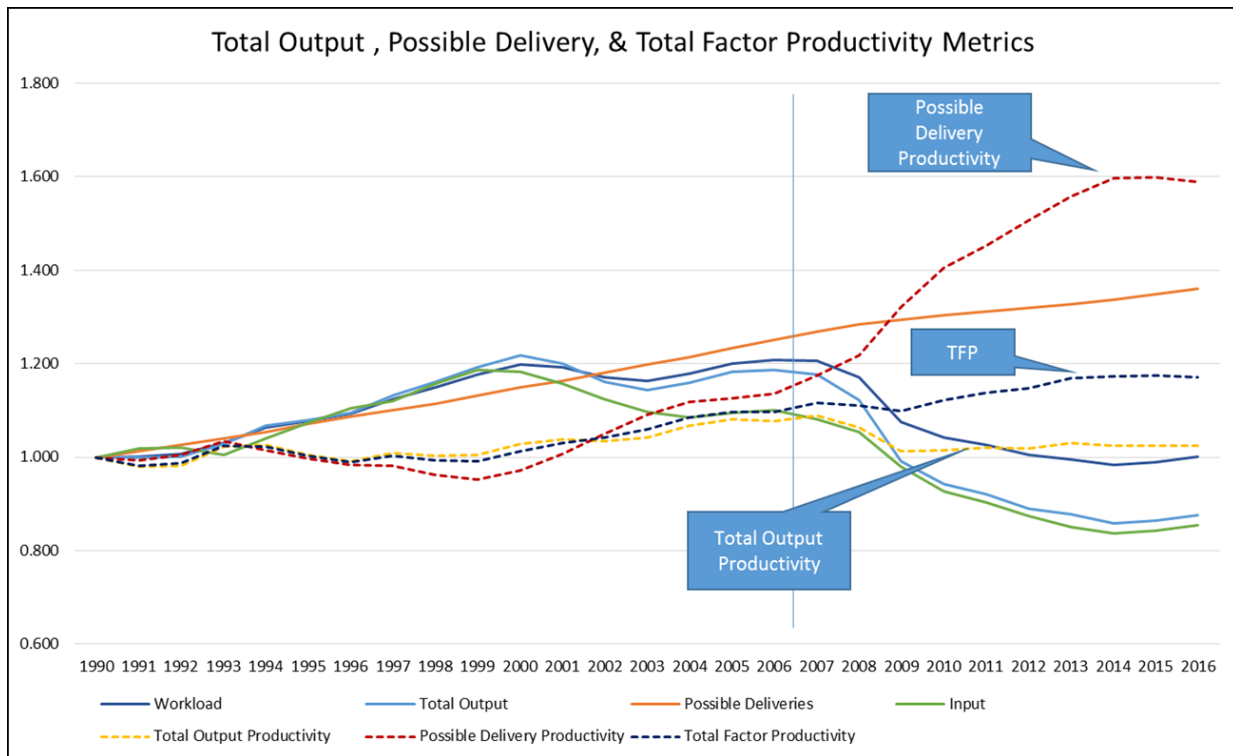


Figure 2 ties together many aspects of the Before and After PAEA productivity analysis into a single graph. The TFP calculation uses Workload in the numerator of the productivity equation. Workload is the combination of the Total Output (Weighted Mail Volume and Miscellaneous Output) and Network (Possible Deliveries).

The alternative productivity metrics are calculated using each of these components as the numerator. Total Output Productivity is a metric based only on mail volume and miscellaneous services. Possible Delivery Productivity is a metric based only on Possible Deliveries, excluding the volume aspect. The report describes implications of these metrics in detail both directly and through analysis of the TFP components.

TFP average yearly growth rates for TFP and its components are presented in Figure 3.

Figure 3: Annual Growth Rates for TFP Metrics

Summary of TFP Process - Annual Growth Rates								
TFP Metric	Before PAEA			After PAEA			Before	After
	1990	1993	2001	2007	2010	2014	1990	2007
	1992	2000	2006	2009	2013	2016	2006	2016
Total Factor Productivity	0.52	0.34	1.33	0.05	1.54	0.04	0.72	0.64
Labor Productivity	1.43	1.23	1.83	0.80	1.92	0.71	1.48	1.22
Postal Inflation Index	4.80	2.03	1.91	4.14	1.46	0.07	2.48	1.85
Network (PDs) Productivity	0.68	-0.44	2.62	5.05	4.10	0.67	0.84	3.35
Total Output Productivity	0.48	0.59	0.77	-2.09	0.45	-0.22	0.63	-0.51
Workload	1.23	2.19	0.13	-3.87	-1.94	0.19	1.30	-1.88
Total Output	1.19	2.45	-0.42	-6.01	-3.03	-0.06	1.21	-3.03
Weighted Mail Volume	1.20	2.50	-0.66	-6.51	-3.21	0.20	1.15	-3.18
Miscellaneous Output	1.01	1.37	3.50	0.17	-1.07	-3.89	2.06	-1.54
Network (Possible Deliveries)	1.39	1.42	1.43	1.13	0.61	0.82	1.42	0.83
Input Total	0.71	1.86	-1.20	-3.92	-3.48	0.15	0.58	-2.52
Labor	-0.19	0.97	-1.70	-4.67	-3.86	-0.52	-0.18	-3.10
Materials - Transportation	5.27	3.99	1.22	-1.57	-2.58	3.10	3.24	-0.58
Materials - Non-Transportation	6.44	5.64	-2.35	-3.92	-1.79	3.64	2.96	-0.80
Capital	5.42	6.07	3.60	2.71	-2.51	-1.33	5.08	-0.59

Report 2 concludes with a summary of the Before and After PAEA analysis and conclusions covering both reports through the following questions:

- A. Is TFP Accurate & Appropriate?
- B. Did the Price Cap improve Postal Service effectiveness?
- C. Is the Postal Service efficient?
- D. Is the Postal Service more efficient After PAEA?

These two reports first provided a thorough analysis of the TFP methodology, then applied the results and components of TFP to the analysis of the Before and After PAEA productivity performance. The Underlying, Exogenous, and Pricing Factors were identified and applied in the analysis of productivity performance.

TFP is a widely accepted as a measure of overall productivity in the Postal Service. Yet it is not understood beyond a conceptual level. The use of TFP is limited to a couple of paragraphs in the Annual Report to Congress. These reports show that TFP could provide a useful and effective role in the evaluation and management of productivity performance for the Postal Service.

II. Approach to PAEA Productivity Analysis

1. General Methodology

A simple Total Factor Productivity (TFP) table is initially announced each year in the Postal Service's Annual Report. The more extensive set of TFP Tables are published each year through the PRC. The consulting firm, Christensen Associates, generates this report. It is provided as an Excel file that contains a series of tables showing the data used and the results of Christensen Associates' TFP model. The Excel file does not contain any formulas, only the values.

This analysis uses the published TFP results, building on the analysis and structure developed in Report 1. This report will reference Report 1 on aspects concerning methodology and process for TFP calculation. The focus of this report is on the analysis of TFP and productivity in the Before and After periods of PAEA

TFP is first submitted at the end of December as a preliminary result for the previous year. The result is preliminary because the Attributable Costs are estimated using the cost per piece from the previous year, multiplied by the current year's pieces. The final report is published later in the year when the final Attributable Costs are available. The data in this report include the 2016 Final TFP Results.

The TFP Tables are organized in different periods of years, usually grouped around major restructuring or reporting changes. NWPC reorganized the data and results in these reports to create a usable data set for analysis and model development. These reports are presented as Appendix 1 – Published TFP Data and Results. This is the source of the graphs and reports provided in this section. The graphs and specific data used in them are provided in Appendix 6 – Graphs Used in Reports.

A. Change of Base Year

The TFP results are calculated using 1972 as the base year. Subsequent yearly changes are then calculated in the form of an index using the 1972 base year. The results can be rescaled to a different base year without changing the underlying numerical relationships. This report uses 1990 as a base year, resetting the index values to one (1.00) in that year. The graphs and results presented here are the result of resetting the base year to 1990.

The TFP methodology calculates a quantity based on a starting value. For example, actual hours in a base or seed year are used to set the starting value. The chained index methodology calculates the quantity for labor input that reflects the relationships between labor hours and cost. One aspect in using 1972 as the base year is that the original metric diverges significantly from the quantity over the 44-year period. As index values are used for the analysis, this divergence does not impact year-to-year results.

The weighted mail volume quantity uses both chained index calculations and pieces directly for different Mail Products. This resulted in an increasing gap between weighted mail quantity and actual pieces over the 44-year period. In 2008, the quantity was reset to 2008 pieces, using a one-time adjustment to transition between the two periods. This was an appropriate adjustment and done at a point where there was a significant change in mail classification categories.

The TFP results are shown on the following page for both the 1972 base year and the 1990 base year.

B. NWPC TFP Before - After TFP Model

NWPC created a Before / After TFP Model to support the analysis in this report. It reset the starting value for the chained index calculations to 1990 for the Labor and Mail Volume calculations. This approach created a continuous data set that avoids the volume adjustment issue in 2008 and a comparison of the results to the source data. For example, the weighted mail volume result could be compared to actual pieces, leading to insight into the impact of the underlying factors. It is provided as Appendix 5.

Figure 4: Total Factor Productivity – 1972 Base Year

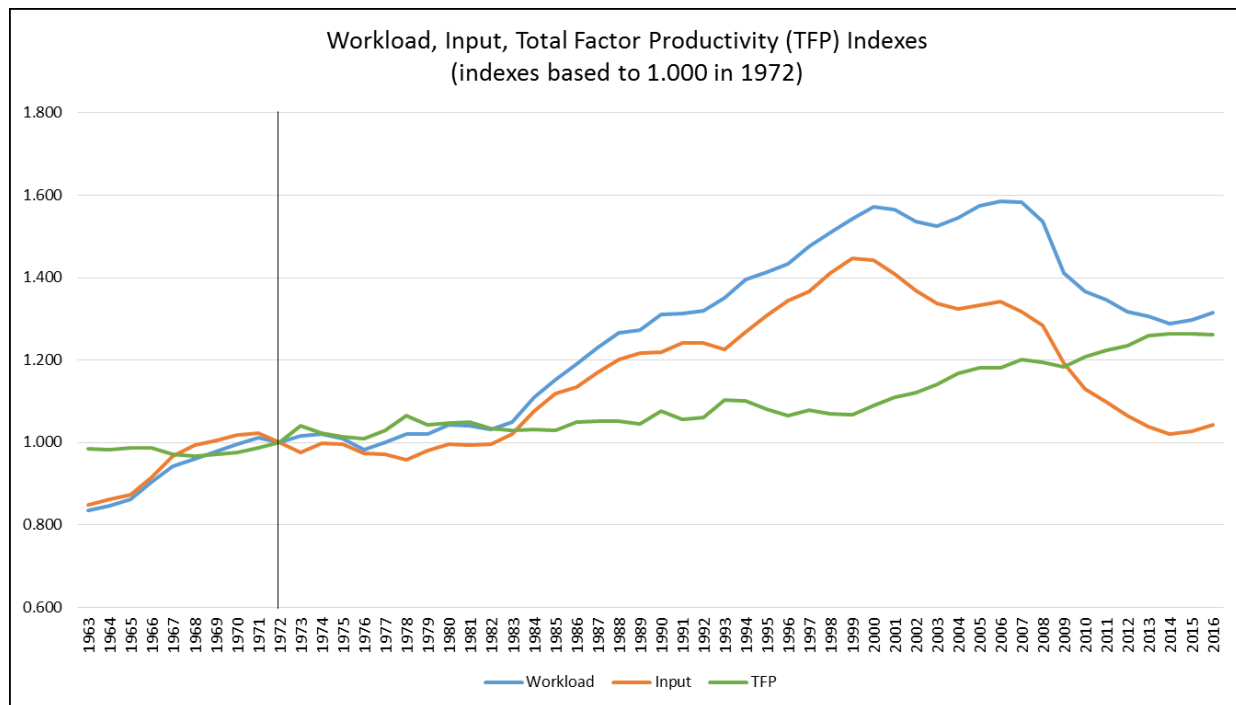
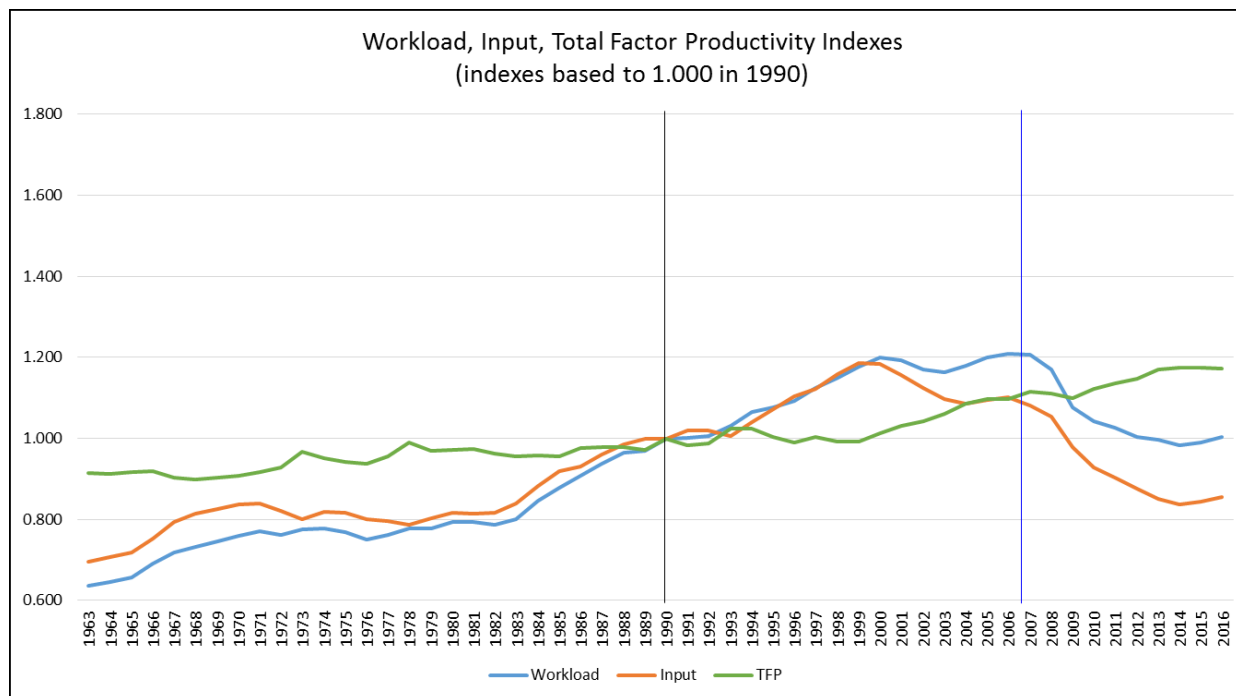


Figure 5: Total Factor Productivity – 1990 Base Year



C. Definitions of TFP Terminology

The following definitions are used in the TFP methodology.

1. Quantity: This is the result of the calculation of the chained value calculation process. It starts out with a seed or starting value in the base year. In general, it is set to the pieces or cost for that base year. Typically, 1972 is used as the base year.
2. Value: This is used for the value of the component. Value is usually dollar-based, either in current dollars or indexed dollars to a base year.
3. Composition of Labor Factor: A component is used in the Labor quantity calculation to reflect the experience level of employees. In general, this becomes a proxy for the changes in wage rate based on the current mix of employees within a category.
4. Composition Hours: This is the actual workhours multiplied by the Composition factor. It is used in the Quantity calculation process instead of actual workhours.
5. Chained Value Index: This is the process using the Tornqvist Index methodology to calculate Quantity for labor occupation categories that have different types of employees. The value is based on the previous year's quantity.
6. Base Year Index: This is the process that calculates Quantity based on a fixed base year, usually 1972. It is used for occupation categories that have a single type of employee.
7. Growth Rates: Growth rates are shown in the published reports. The Growth Rate is calculated using the natural logarithm formula rather than the traditional percentage change over the previous year. The use of a logarithm formula allows the values for individual years to be added together directly to get the cumulative growth over multiple years.
8. Weighted Mail Volume: The result of the index calculation to combine the change in pieces with the share of the attributable cost for Mail Products and Classes.
9. Miscellaneous Output: The component of output from Ancillary Services, Special Services, Competitive Services, and Other Services.
10. Total Output: Total Output is the combination of the Weighted Mail Volume and the Miscellaneous Output.
11. Network: Network is the component of workload that represents the delivery network. It is the Possible Deliveries for the Postal Service.
12. Workload: Workload is the combination of the Total Output (Weighted Mail Volume and Miscellaneous Output) and the Network (Possible Deliveries). It is the numerator in the general productivity equation.
13. Input: Input is the composite index of the Labor, Materials, and Capital components. It is the denominator in the productivity equation.
14. Total Factor Productivity (TFP): It is the Workload divided by the Input.
15. Labor Productivity Index: It is the Workload divided by the Aggregate Labor Index (instead of Input).
16. Postal Inflation Index: The index of the Resources Value (current dollars of Labor and materials, and value of Capital) divided by the Workload.

2. Underlying Factors

The Underlying Factors are those that are considered as within the Postal Service's control or influence. These can be grouped into those programs that have specific operational efficiency goals such as converting to a much more automated processing platform or strategic in nature such as trying to obtain a more flexible workforce.

A. Operational Programs

1. Letter Automation - Sorting: The sorting of letters has transitioned from a manual operation to essentially a fully automated process. The first phase occurred in the 1970's as mail began moving from a manual sorting process to a more mechanized process focused on the use of the letter sorting machine (LSM). The next process of moving to a mechanized to an automated environment had two main phases – the automation of mail processing and the implementation of full delivery point sequencing (DPS). For mail processing, the 1990's saw the elimination of the LSM processing. The deployment of Delivery Barcode Sorters (DBCS) began to make an impact in the mid-1990's as large numbers of these sorters were deployed to support the carrier route sort, followed by sector-segment and DPS processing.

The implementation of the Remote Barcoding System (RBCS) and the handwritten recognition improvements for automated sorters has mostly eliminated manual piece sorting for letters. Remote Encoding Centers (RECs) first saw an expansion then a subsequent contraction as handwritten recognition on the automated sorters at the plants replaced the need for keying operations at the REC's.

2. Letter Automation – Delivery: The implementation of DPS was a phased process. It started with Sector-Segment processing which focused on sorting mail to segments of a carrier's route in the mid-1990's. DPS replaced sector-segment, with savings in delivery being achieved as the percentage of letters in DPS increased to levels sufficient to realize route restructuring. Effectively, more of the carriers' mail was sequenced in the order the carrier traveled the route. This meant that the carriers spent less time sequencing their mail in the office and more time could be spent actually delivering the mail on the street. That extra time became the basis to realize route restructuring, which allowed carriers to deliver mail to more delivery points. This covered the period of 1996 to full implementation in 2009. DPS sequenced around 70% of letters in carrier walk order in 2000. That percentage reached 90 percent in 2008 and has remained in the 90 to 93 percent range since 2008.
3. Flats Automation - Sorting: Flats automation followed the letter automation process. The implementation of the Advanced Flat Sorter Machine (AFSM) replaced the mechanized FSM equipment starting in 2002. The sorting of flats to carrier route in mail processing was fully automated through the AFSM.

4. Flats Sequencing System (FSS): Deployment of the FSS equipment began in 2009 and ended in 2012. This piece of equipment was designed to sequence flats in carrier walk order in much the same manner as DPS had done for letters. Since 2012, implementation of zone coverage, which focuses the use of FSS on certain zones, and other changes have been implemented. The flats characteristics and volumes result in FSS being economically viable for only locations where density and other factors support the automated sorting.
5. Parcel Sorters: The growth of parcels, particularly Priority Mail and First Class Mail Parcels, has resulted in a series of equipment deployments to meet the growing capacity requirements for sorting. The Automated Package & Parcel Sorter (APPS) program starting in 2005 was the largest program centered on package and bundle sorting.
6. Carrier Route Realignment Process: The changes in mail at the carrier route level require the ongoing management and realignment of the route structure. This program has become a major component of productivity management of carrier operations. It transitioned over the years from management of volume growth to management of volume contraction and shifting of mail mix, both of mail type (e.g., First Class Mail volume reduction and parcel growth) and preparation (e.g., DPS and FSS).
7. Lean Six Sigma / Operational Industrial Engineering: These tools, which came to the forefront at the Postal Service by 2008, allow for operational problems to be diagnosed and solved in a methodical manner focusing on root causes and solutions.

B. Strategic Programs

1. Workshare Programs: The workshare programs shifted the workload of sorting and transporting of mail to mailers in exchange for discounted rates. Two aspects of these programs are presort discounts in exchange for customers sorting mail to a specific level and discounts for “dropping” mail at destination facilities. The following specific programs will be examined in the TFP results.
 - a. First Class Presort: The impact on weighted mail volume of presort versus non-presort is shown.
 - b. Standard Carrier Level Preparation: The impact on weighted mail volume of carrier level preparation versus other sort level preparation is also shown.
 - c. Parcel Select: The changes in the broad category of parcels across all Mail Products are shown. The growth of Parcel Select is shown in the context of all package categories and the impact on TFP is examined.
2. Mail Classification: Mail classification changes are shown through the years in the mail volume reports.

3. Network Realignment: The network optimization and mail processing plant consolidation had been an ongoing process as operational programs and electronic diversion affected operations. Prior to 2011, it had been done as an ongoing management process, primarily structured around the Area Mail Processing (AMP) program. In 2012, network consolidation was formalized under Docket N2012-1 (Mail Processing Network Rationalization Service Changes), encompassing a restructuring of the entire mail processing network through a substantial reduction of overnight First Class Mail service and restructuring of service standards. The change in mail processing operational windows is considered in this category for report purposes.
4. Intelligent Mail Program: The Intelligent Mail Program built upon previous mailer barcode incentives to build a fully integrated process of information technology where information on mail being processed or delivered could be provided to both customers and the Postal Service.
5. Non-Career Workforce Utilization: In 2011, the labor contract negotiation process produced a significant expansion in the use of non-career employees. This resulted in a substitution of higher cost career hours with lower cost non-career hours. The use of a higher mix of lower cost non-career employees reduced the composite wage rate for Clerks / Mailhandlers and City Carriers.

The use of additional non-career employees also occurred in the automation program in the 1990's and early 2000's. Transitional Employees (TEs) were used for some short-term, interim automation steps to mitigate the impact of automation on career employees as these processes were phased out. Transitional Employees ended in 2003 along with increased limits on the use of casual employees.

6. POSt Plan: The POSt Plan was implemented in 2012 and completed in January 2015. This plan eliminated some low-volume retail offices and limited the hours in a number of other offices.
7. Transportation Programs: Transportation is historically about half of the total Materials cost. There have been major program changes in Transportation over the years. The most notable is the activation of the FedEx network in 2001.

3. Exogenous Factors

Exogenous Factors are those that come from outside the Postal Service, over which the Postal Service has little or no ability to directly control. The examination of the impact of exogenous factors on productivity measurement through quantitative and qualitative methods is a key objective in Report 2. A goal of this report is to ensure these factors are clearly defined and examined as part of the results. The following exogenous factors form the initial starting point for this analysis:

1. Electronic Diversion: The impact of increased electronic communication and payments on mail volumes. The trend became noticeable in the early 2000's as many households obtained online capabilities and grew with the "Great Recession" beginning in 2008. There were several visible outcomes of this phenomenon.
 - The reduction of "clean" easy-to-process mail such as bill remittances which is considered high margin/low cost mail.

- The elimination of bill statements each month. This mail was primarily First Class Mail Presort.
 - After peaking in 2001-2002, First-Class Mail volume began its decline which has continued. The relationship of Presort versus Non-Presort in First Class Mail is examined later in the report.
2. eCommerce: The growth of package volumes due to ecommerce, including the role of work sharing product categories (e.g., DDU Parcel Select) along with greater visibility through Delivery Confirmation. The impact of adding more volume that involves a greater workload (i.e., compared to letters) should be evaluated. One thought is that the major shift in parcels with a higher operational cost naturally leads to a lower overall productivity measurement result. TFP also considers the cost of Delivery Confirmation in the Miscellaneous Output component of Workload.
 3. Marketing / Advertising Mail: The large growth of advertising in the early 1980's led to substantially more Standard Mail volume. Advertisers also used First-Class Mail as an advertising vehicle giving that product a bump. The use of mail then began to play a lesser role as eCommerce and electronic diversion offered viable alternatives. The competition for marketing resources contributed to volume declines, particularly as the recession impacts began in 2008.
 4. Economy / Recession: The economy directly impacts mail volumes, and to a lesser extent, the growth in Possible Deliveries, i.e., the delivery network. The Great Recession resulted in a historic drop in mail volumes. This volume drop was enhanced by the impacts of electronic diversion, eCommerce, and shifts in the use of mail in marketing. Two other recessions in 1991 and 2001 also had an impact.
 5. Anthrax Attacks: The 2001 anthrax attacks involved sending anthrax-laced letters in the mail killing two postal employees and three other individuals. The attacks resulted in some temporary loss of public confidence in the mails and contributed to reduced postal volumes.
 6. Year 2000 (Y2K) Computer Compliance: The effort to comply with the Y2K computer requirements did cause an observable spike in Miscellaneous Services and Professional Services in 1998, 1999, and 2000.

4. Pricing Factors / Price Restraints

As with the preceding underlying and exogenous factors, the factors related to pricing (including restraints) are identified in this section. However, the changes in TFP related to pricing are difficult to directly observe in the results. The impact on productivity of pricing restraints is indirectly reflected in the underlying factors, those within the control of the Postal Service. It is nearly impossible to prove that the Price Cap directly caused the variety of cost reduction activities. There are no statements to the effect that a particular action was caused by the Price Cap. At the same time, a number of management programs, initiatives, and strategic decisions were made coincident with the Price Cap. As such, it could be inferred that the implications of the Price Cap led to, or at least contributed to, some of the aggressive cost related strategies in the After PAEA period.

The pricing factors are identified below. In some cases, these are similar to underlying or exogenous factors.

1. Price Cap: The Price Cap was effectively implemented in 2007 as PAEA was enacted into law at the close of 2006. With the exception of the exigent rate increase, all of the subsequent rate increases for market dominant products were limited by the CPI-U price cap.
2. Presort Discounts: The first presort discounts were implemented in 1976. These discounts allowed customers to begin taking over some of the mail sorting activities formerly done by the Postal Service. The Standard Mail carrier route presort discount was implemented in 1978 and proved fortuitous in allowing the Postal Service to realize its share of the growth in the advertising market in the early 1980's.
3. Automation Discounts: A number of discounts were implemented in 1991 that encouraged customers to barcode and prepare their mail in a manner that made it easier to process letters on the automation equipment.
4. Dropship Discounts: A number of dropship discounts were implemented in 1991 that encouraged Standard Mail, Periodicals and Parcel Post customers to deposit their mail closer to the point of delivery thereby bypassing transportation legs and interim handlings.
5. Parcel Select: The management of the growth of package volumes due to ecommerce, including the role of worksharing product categories (e.g., DDU Parcel Select in 1999).
6. Delivery Confirmation: In 1999, Delivery Confirmation, which allowed parcel shippers to gain more visibility into the delivery of their product, was implemented.
7. Reclassification 1996: Reclassification was implemented in 1996. It used postal rates and mail preparation requirements to further encourage barcoding and more automation compatible mail.
8. Postal Accountability Enhancement Act (PAEA): PAEA was enacted at the end of 2006. Rate increases for market dominant products, which accounted for most of the USPS revenue, were limited to the annual increase in the CPI-U.
9. Standard Mail Flats, 2007: Significant changes to Standard Mail flat rates in 2007 had an impact on Standard Mail volumes and workload.
10. First Class Parcels, 2007: In 2007, the formal commercial First-Class Mail parcel category was created. In 2012, commercial First-Class Mail parcels were moved from the market dominant category to the competitive category.
11. Standard Mail Parcels, 2007: In 2007, the formal Standard Parcel category was created. In 2012, Standard Parcels were moved from the market dominant category Parcel Select in the competitive category.
12. New Postal Products 2008: As mandated by the PAEA, postal classifications were reorganized into products in 2008. Many of these products focused on mail processing shape characteristics (letter, flats, and parcels). Moreover, the widespread product reorganization, along with gradual increases in the difference between mail volumes as reported by the RPW and mail quantity as measured by TFP calculations led to a truing up of the TFP mail quantities in 2008.

5. Other Factors & Considerations

Another issue is whether service changes, specifically the recent declines, should be factored into the analysis of TFP results or directly into the calculation methodology. While the PRC's concern about cost reductions that result in service declines is appreciated, that issue may be better addressed directly through the review of various service measures. It is difficult to create a measure to account for service results in a productivity-based methodology.

One alternative would be to make arbitrary deductions in an objectively calculated productivity measure. It would seem to be incongruent to perform a myriad of precise calculations for TFP measurement and then make an arbitrary change at the end offsetting much of that effort. Another alternative would be to take the cost savings due to service changes and somehow place them in the input base. Again, a complex set of calculations would be offset by assumptions on cost savings. There is already a system of service standards and performance that provide an assessment of service performance. It would appear that this information, standing alone, would serve as the basis for any action by the PRC.

Service measurement should be considered separately from productivity measurement. These are two separate and distinct aspects of performance in terms of measurement methodology. The two should be considered together in the process of analyzing overall performance. This report is focused on the productivity aspect of performance.

TFP is considered a productivity measure designed for analysis over large period of years. The TFP methodology is based on the Tornqvist Index calculation process. It is intended for use in calculating productivity over a period of years. It is a symmetric weight index, meaning it uses the average costs over a two-year period when looking at the change in Quantity from year to year.

Consequently, the results are smoothed out over a period of years. As a result of this smoothing, the value of growth can be suppressed over a non-symmetric weighting methodology. A system of suppressed growth rates can lead to suppressed goals. For instance, when the Postal Service set a goal for TFP for the 1998 – 2002 Strategic Plan, it was set at 0.50 percent annually. This might not seem like an aggressive target to some observers. This aspect of TFP should be considered in evaluating the annual growth rate changes in TFP. It also puts the high growth in TFP in the period 2000 to 2007 at 1.33 percent into perspective.

III. TFP Productivity Before & After PAEA

The analysis of TFP productivity of the Before PAEA and After PAEA periods will start with the three primary results indexes of TFP: the Total Factor Productivity index, the Labor Productivity Index, and the Postal Inflation Index. The analysis will then examine alternative measures of productivity that can be calculated from the components in the TFP methodology. Finally, the components will be reviewed to further identify the impacts of the underlying, exogenous, and pricing factors.

1. Productivity Results – Published Indicators

A. Total Factor Productivity

As a general definition, productivity is the result of dividing a measure of output with a measure of resources. The definition of Total Factor productivity is expressed through the following formulas:

$$\text{Total Factor Productivity Index} = \text{Workload Index} \div \text{Input Index, or more simply,}$$

$$TFP = \text{Workload} \div \text{Input}$$

The Workload Index is the result of combining, through a weighting formula, the Network Index (Possible Deliveries) and Total Output Index. The Total Output Index is the combination of Weighted Mail Volume and Miscellaneous Output (e.g., PO Boxes).

The Input Index is the combination of the Labor, Materials and Capital Indexes. It represents the resources used for the workload of mail volume, miscellaneous activities, and the delivery network. The term Resources is also used for Total Input.

Figure 6 shows the Workload, Input, and Total Factor Productivity with 1990 set as the base year. TFP performance over these years can be segmented based on clear segments of performance that will be related to the underlying, exogenous, and pricing factors:

<u>Years</u>	<u>TFP Average Growth Rate</u>	<u>Period Summary</u>
1990 – 1992	0.52%	Small recession with flat workload growth
1993 – 2000	0.34%	Solid volume growth with early automation programs
<u>2001 – 2006</u>	<u>1.33%</u>	<u>Flat workload with significant drop in Input, high TFP growth</u>
Before PAEA	0.72%	Long period of improvement at PAEA enactment
2007 – 2009	0.05%	Great Recession. Large workload declines. TFP is flat.
2010 – 2013	1.54%	Workload drops, Input drops more, for a large TFP increase
<u>2014 – 2016</u>	<u>0.04%</u>	<u>Workload starts increasing again, flat TFP growth</u>
After PAEA	0.64%	Recession and volume drop matched with Input reductions

These groups of years will be used as a structure for the analysis of the Before PAEA and After PAEA periods.

Figure 6: Total Factor Productivity with Base Year 1990

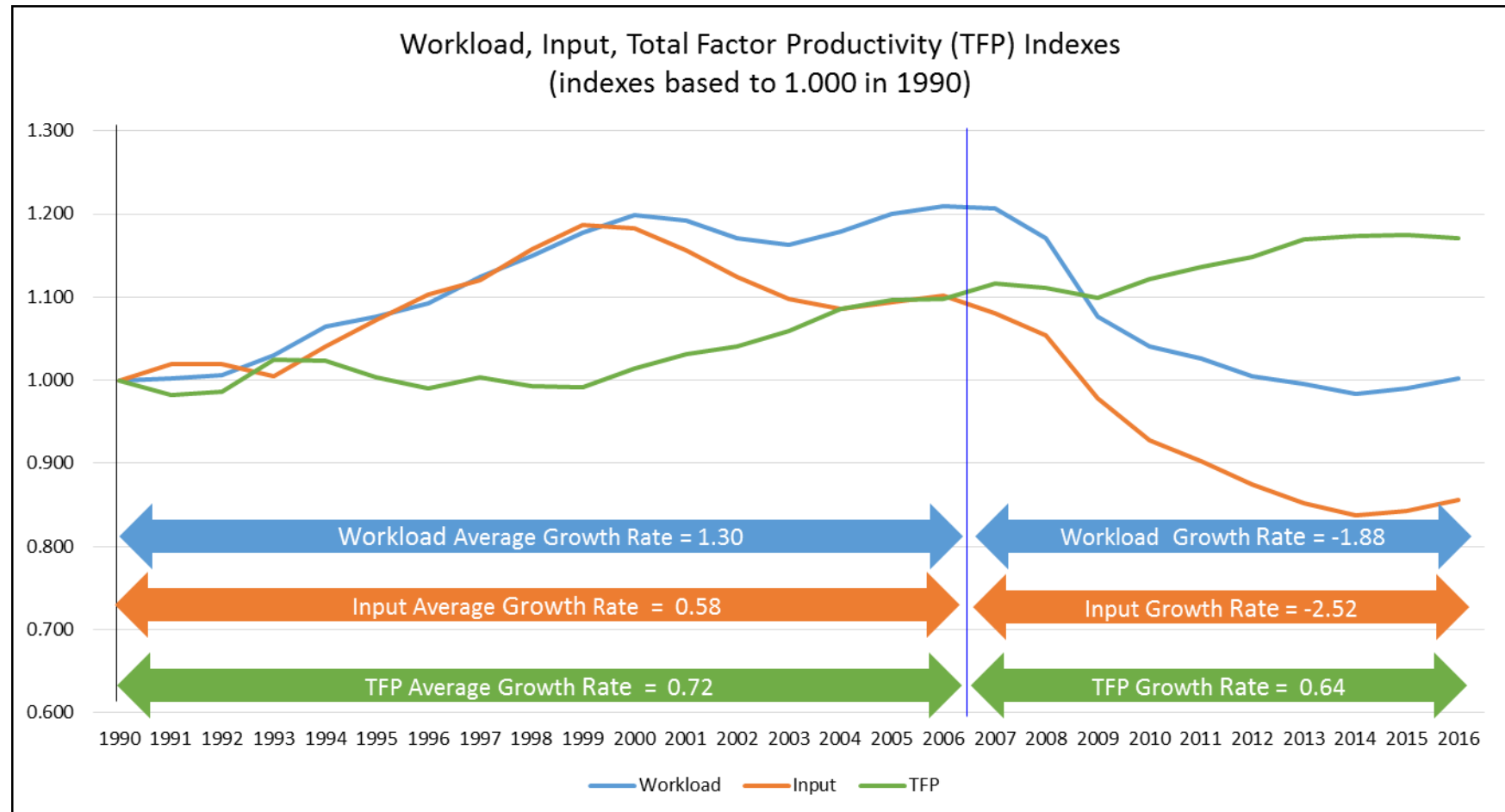
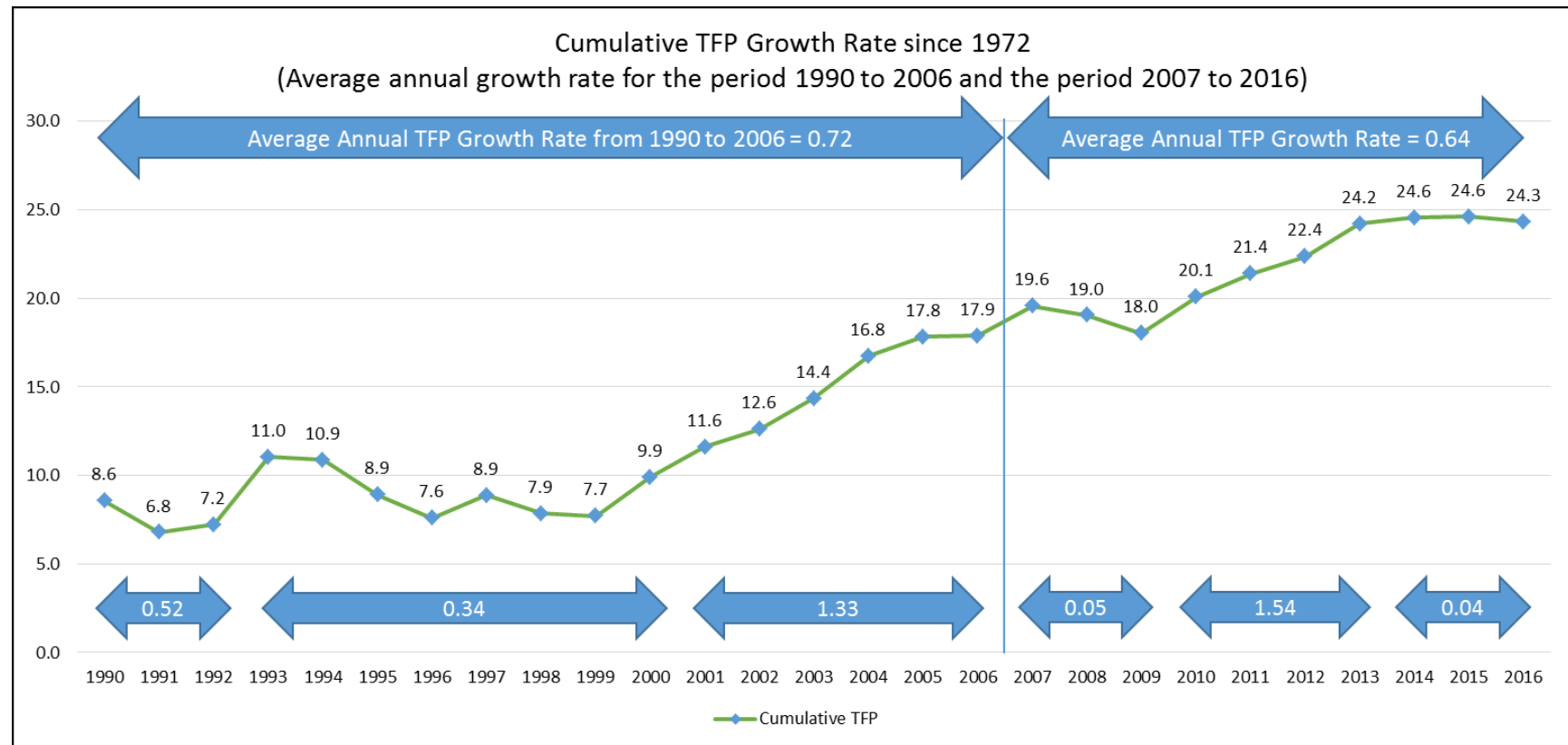


Figure 7: TFP Cumulative Growth Rate



- This graph format is used in the Annual Reports, the Annual Report to Congress, and other productivity studies.
- It shows the Cumulative Growth in TFP since the base year of 1972.
- The Cumulative Growth in TFP was 8.6% in 1990.

Figure 8: TFP Time Periods with Underlying, Exogenous, and Pricing Factors

Period	Work-load	Input	TFP	Underlying Factors	Exogenous Factors	Pricing Factors
1990 - 1992	1.23	0.71	0.52	<ul style="list-style-type: none"> • Letter Automation – Sorting • FSM Automation - Sorting 	<ul style="list-style-type: none"> • 1991 Recession. 	<ul style="list-style-type: none"> • Dropship introduced in 1991
1993 - 2000	2.19	1.86	0.34	<ul style="list-style-type: none"> • Letter Automation matures • Flats Automation - Sorting 	<ul style="list-style-type: none"> • Strong economy leads to strong volume growth. • Y2K 	<ul style="list-style-type: none"> • 1996 Reclassification emphasizes automation in mail prep and rates. • Standard Volume leads growth.
2001 - 2006	0.13	-1.20	1.33	<ul style="list-style-type: none"> • DPS matures, carrier savings • Parcel Sorters – APPS • Loss of non-career in Clerk/MH 	<ul style="list-style-type: none"> • Electronic diversion becomes visible in trends. • 2001 Recession • Anthrax Attacks in 2001 	<ul style="list-style-type: none"> • Parcel Select DDU Drop Ship • Delivery Confirmation
2007 - 2009	-3.87	-3.92	0.05	<ul style="list-style-type: none"> • Parcel Sorters – APPS • AMP process for mail processing. • Operational reaction to volume drop • First VERA in 2009 	<ul style="list-style-type: none"> • Recession led to historic volume drop • Electronic diversion on First Class. 	<ul style="list-style-type: none"> • Price Cap period begins • Substantial Standard Flat price increase in 2007. • Creation of Standard and First Class parcel categories in 2007 • Classification reform into product groupings in 2008.
2010 - 2013	-1.94	-3.48	1.54	<ul style="list-style-type: none"> • Mail Processing network reduction & service standard change, • Delivery route reduction program, • And POST Plan initiated. • FSS • Carrier Route realignment & PD growth management • Parcel sorter expansion 	<ul style="list-style-type: none"> • Volume drop continued, to reduction in PD growth. • Electronic diversion increases. • eCommerce volume growth in package products • Attributable cost loss of FCM covered by package products. 	<ul style="list-style-type: none"> • Price Cap drives cost reduction – input reductions matches Total Output reductions. • Price Cap influences labor negotiations. • In 2012, FC Commercial and Standard parcels to Competitive.
2014 - 2016	0.19	0.15	0.04	<ul style="list-style-type: none"> • Substitute career for non-career hours drops composite wage rate. • Service concerns suspend Network realignment, increase resources address service. • Lean Six Sigma 	<ul style="list-style-type: none"> • Parcel volume grows. • FC & Standard volume levels out • Attributable cost loss of FC covered by package products. 	<ul style="list-style-type: none"> • Price Cap drives cost reduction. • Exigent Rate Increase.

Figure 9: Total Factor Productivity – Growth Rates for TFP, Workload, & Input

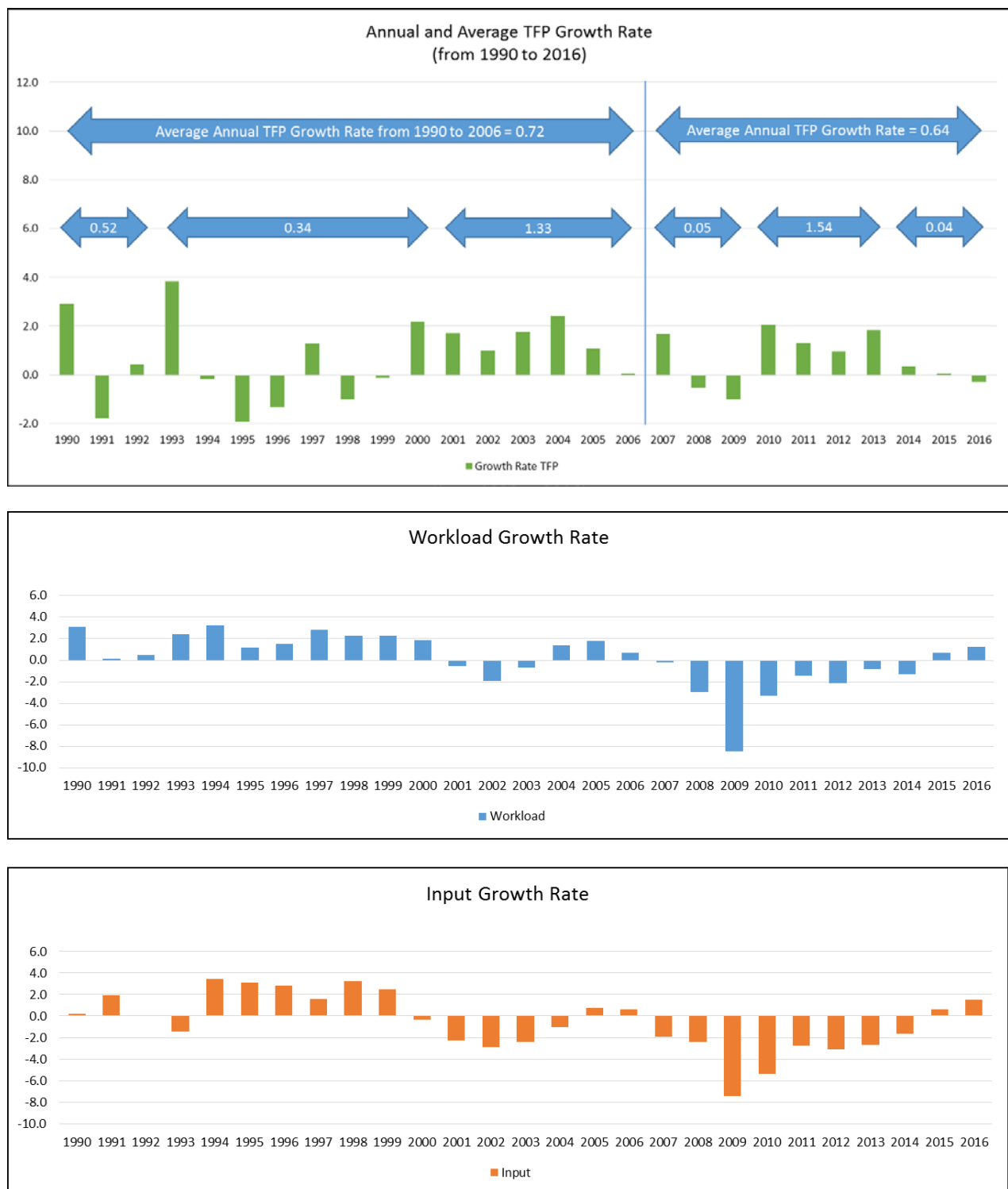


Figure 10: Published Result – TFP 2016, Reset to 1990 Base Year

Year	Total Factor Productivity			Growth Rates (%)		
	Workload	Input	TFP	Workload	Input	TFP
1990	1.000	1.000	1.000	3.08	0.19	2.90
1991	1.002	1.020	0.982	0.16	1.94	-1.77
1992	1.006	1.020	0.987	0.45	0.02	0.43
1993	1.031	1.005	1.025	2.39	-1.44	3.83
1994	1.064	1.040	1.023	3.24	3.42	-0.18
1995	1.077	1.073	1.004	1.16	3.10	-1.95
1996	1.093	1.104	0.990	1.50	2.83	-1.33
1997	1.125	1.121	1.003	2.84	1.56	1.28
1998	1.150	1.158	0.993	2.25	3.26	-1.01
1999	1.177	1.187	0.992	2.31	2.45	-0.14
2000	1.199	1.183	1.014	1.87	-0.32	2.19
2001	1.193	1.157	1.031	-0.53	-2.24	1.71
2002	1.171	1.124	1.041	-1.89	-2.87	0.98
2003	1.163	1.097	1.060	-0.65	-2.41	1.75
2004	1.179	1.086	1.085	1.36	-1.04	2.40
2005	1.200	1.094	1.097	1.81	0.75	1.06
2006	1.209	1.101	1.098	0.70	0.65	0.06
2007	1.206	1.081	1.116	-0.22	-1.90	1.68
2008	1.171	1.054	1.111	-2.96	-2.44	-0.52
2009	1.076	0.979	1.099	-8.43	-7.43	-1.00
2010	1.041	0.928	1.122	-3.31	-5.35	2.04
2011	1.026	0.903	1.137	-1.46	-2.77	1.31
2012	1.004	0.875	1.148	-2.16	-3.13	0.97
2013	0.996	0.852	1.170	-0.83	-2.68	1.85
2014	0.983	0.838	1.174	-1.31	-1.65	0.35
2015	0.990	0.843	1.174	0.66	0.61	0.06
2016	1.002	0.856	1.171	1.21	1.51	-0.30

B. Labor Productivity Index

The Labor Productivity Index (LPI) is the Workload divided by the Labor component of Total Input. It shows a continuous improvement starting after the 1991 recession period. This improvement is primarily attributable to the underlying factors related to automation programs in mail processing and delivery.

The Labor Productivity Index results are shown on the following page. The entire 54-year results reset to the 1990 base year are shown in Figure 11. The 27-year period starting in 1990 is shown in Figure 12.

The table below shows the Average LPI growth rate and a summary for the period.

<u>Years</u>	<u>LPI Average Growth Rate</u>	<u>Period Summary</u>
1990 – 1992	1.43%	Early implementation of the Corporate Automation Plan
1993 – 2000	1.23%	Letter & flat sorting automation, high volume growth
<u>2001 – 2006</u>	<u>1.83%</u>	<u>Maturity of sorting automation, DPS & electronic diversion</u>
Before PAEA	1.48%	Automation programs, work sharing, and management
2007 – 2009	0.80%	Historic Volume drop was matched by ability to reduced labor
2010 – 2013	1.92%	Cost reduction focus reduced labor faster than volume drop
<u>2014 – 2016</u>	<u>0.71%</u>	<u>Workload begins increasing, non-career employee impact</u>
After PAEA	1.22%	Recession and volume drop matched with Input reductions

The following observations can be made on LPI:

- Starting in 1997, labor productivity has increased in almost every year.
- The labor growth rate has tended to reflect the workload growth rate but at a slightly lower rate resulting in labor productivity growth.
- There were increases in labor in the 1990's, but these were less than the increases in workload.
- There were larger declines in labor than workload starting in 2001.
- Labor has grown in the past two years but at a smaller rate than workload.
- Labor growth in the past two years is lower than workhour growth due to the substitution of higher cost wages with lower cost non-career wages.
- The section on Labor later in the report shows the details of the employee classification categories on the total Labor Index.

Figure 11: Labor Productivity, 1990 Base Year

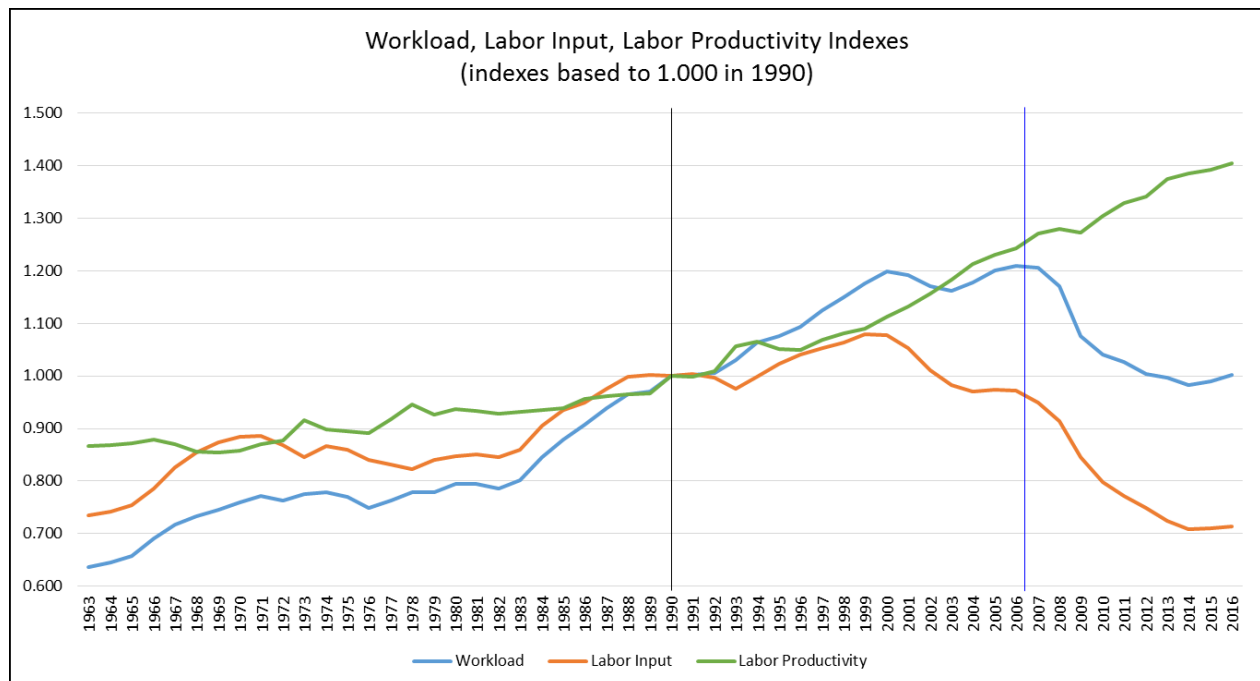


Figure 12: Labor Productivity - 1990 to 2016 with 1990 as Base Year

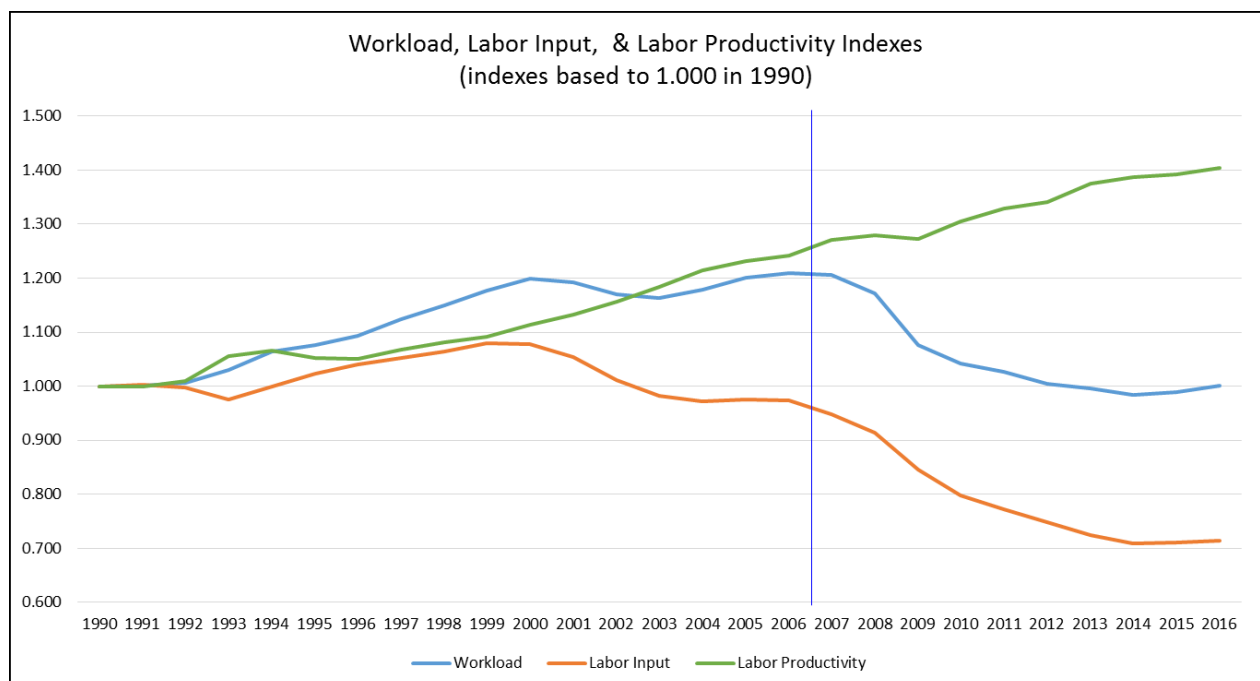


Figure 13: Labor Productivity - Growth Rates for Index, Workload, & Input



Figure 14: Labor Productivity Index

Year	Workload, Labor, Productivity Indexes			Growth Rates (%)		
	Workload	Labor Input	Labor Productivity	Workload	Labor Input	Labor Productivity
1990	1.000	1.000	1.000	3.08	-0.29	3.37
1991	1.002	1.003	0.999	0.16	0.30	-0.14
1992	1.006	0.997	1.009	0.45	-0.59	1.04
1993	1.031	0.976	1.056	2.39	-2.18	4.57
1994	1.064	0.999	1.065	3.24	2.40	0.84
1995	1.077	1.024	1.052	1.16	2.44	-1.28
1996	1.093	1.041	1.050	1.50	1.61	-0.11
1997	1.125	1.053	1.068	2.84	1.16	1.69
1998	1.150	1.064	1.081	2.25	1.05	1.20
1999	1.177	1.079	1.091	2.31	1.42	0.89
2000	1.199	1.077	1.113	1.87	-0.15	2.02
2001	1.193	1.053	1.133	-0.53	-2.27	1.73
2002	1.171	1.011	1.157	-1.89	-4.05	2.16
2003	1.163	0.982	1.184	-0.65	-2.92	2.27
2004	1.179	0.971	1.214	1.36	-1.14	2.50
2005	1.200	0.975	1.231	1.81	0.38	1.44
2006	1.209	0.973	1.243	0.70	-0.20	0.90
2007	1.206	0.949	1.272	-0.22	-2.53	2.31
2008	1.171	0.915	1.280	-2.96	-3.64	0.67
2009	1.076	0.846	1.273	-8.43	-7.86	-0.58
2010	1.041	0.798	1.305	-3.31	-5.80	2.49
2011	1.026	0.772	1.329	-1.46	-3.29	1.83
2012	1.004	0.749	1.342	-2.16	-3.11	0.95
2013	0.996	0.725	1.375	-0.83	-3.26	2.43
2014	0.983	0.709	1.386	-1.31	-2.14	0.84
2015	0.990	0.711	1.392	0.66	0.26	0.41
2016	1.002	0.713	1.404	1.21	0.34	0.88

C. Postal Inflation Index

The Postal Inflation Index is the Value of the resource usage divided by the Workload. The Value of the resource usage is the sum of the Labor, Capital, and Materials Value result.

- Effectively, it is the cost change that cannot be explained by the change in workload.
- Postal inflation increased relatively consistently from 1963 until 2008 when resource usage stabilized and postal inflation abated.

The table below shows the Average Postal Inflation Index growth rate and a summary for the period.

<u>Years</u>	<u>PII Average Growth Rate</u>	<u>Period Summary</u>
1990 – 1992	4.80%	Resources are rising faster than workload in recession.
1993 – 2000	2.03%	Relatively consistent growth rate over years.
<u>2001 – 2006</u>	<u>1.91%</u>	<u>After leveling in 2001-03, growth resumed.</u>
Before PAEA	2.48%	Postal Inflation Index closely followed CPI-U.
2007 – 2009	4.14%	Recession led to volume drop, costs did not follow as fast.
2010 – 2013	1.46%	After a spike in 2001, resources declining relative to workload.
<u>2014 – 2016</u>	<u>0.07%</u>	<u>Resources closely matched Workload.</u>
After PAEA	1.85%	After the Recession, Resources matched Workload.

The urban Consumer Price Index (CPI-U) is used as the basis for the Price Cap process under PAEA. It is a commonly used measure of inflation in the economy in general. The Postal Inflation Index compares the actual dollar values for Labor and Materials, and the Value of Capital, to the Workload. It shows the relationship between actual costs with workload.

Simply stated, the Postal Inflation Index is the measure of inflation for all the resources used by the Postal Service after accounting for changes in workload. It represents the current cost to the Postal Service for producing a single unit of output. Consequently, a comparison of these two metrics can provide insight into the relationship between actual postal specific cost pressures along with the more general inflation in the economy as depicted by with the CPI-U.

Several observations are worth noting in the Figure 15 and Figure 16.

The CPI-U and Postal Inflation have tracked remarkably closely since both 1972 and 1990.

- Since 2014, Postal Inflation has actually been slightly less than the CPI-U and actually declined for 3 years in a row until 2016.

Figure 15: Postal Inflation Index with CPI-U

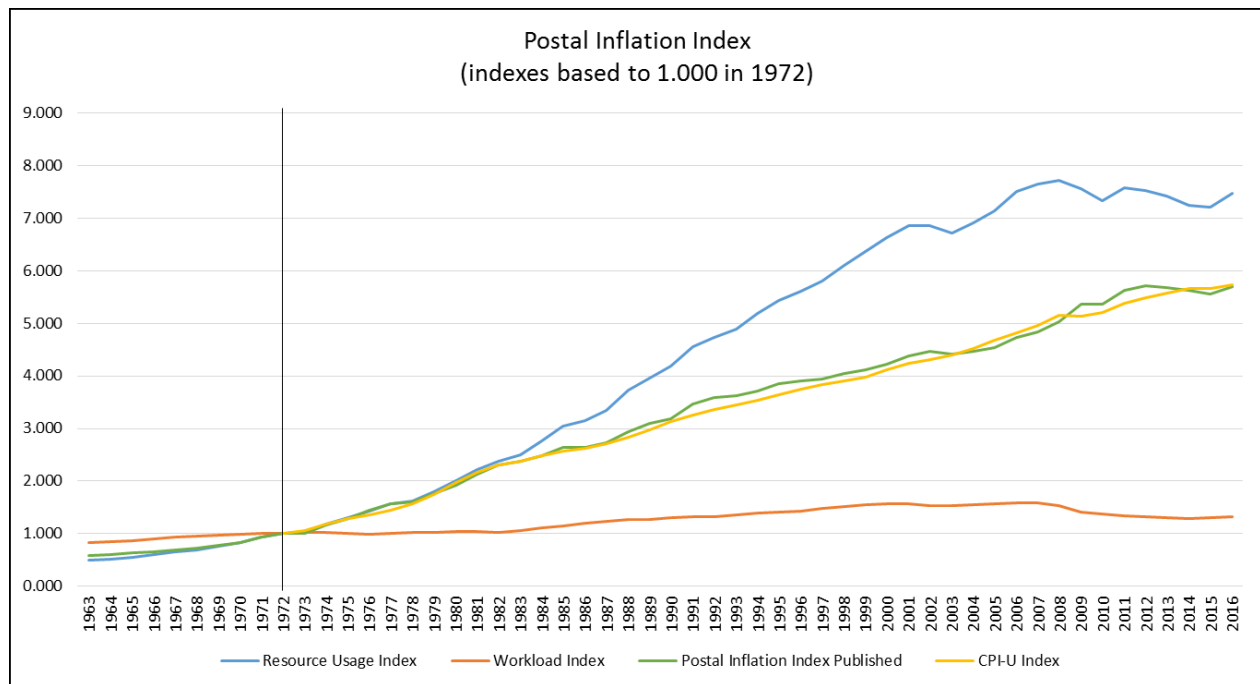


Figure 16: Postal Inflation Index with CPI-U, Base Year 1990

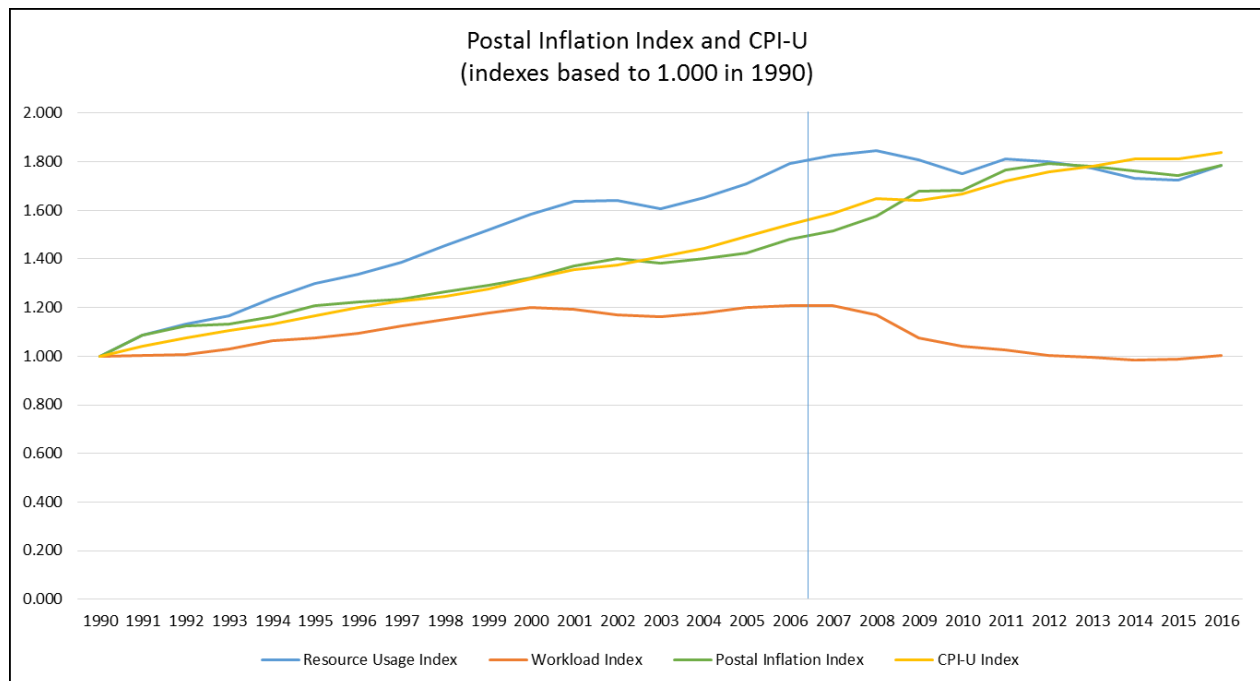
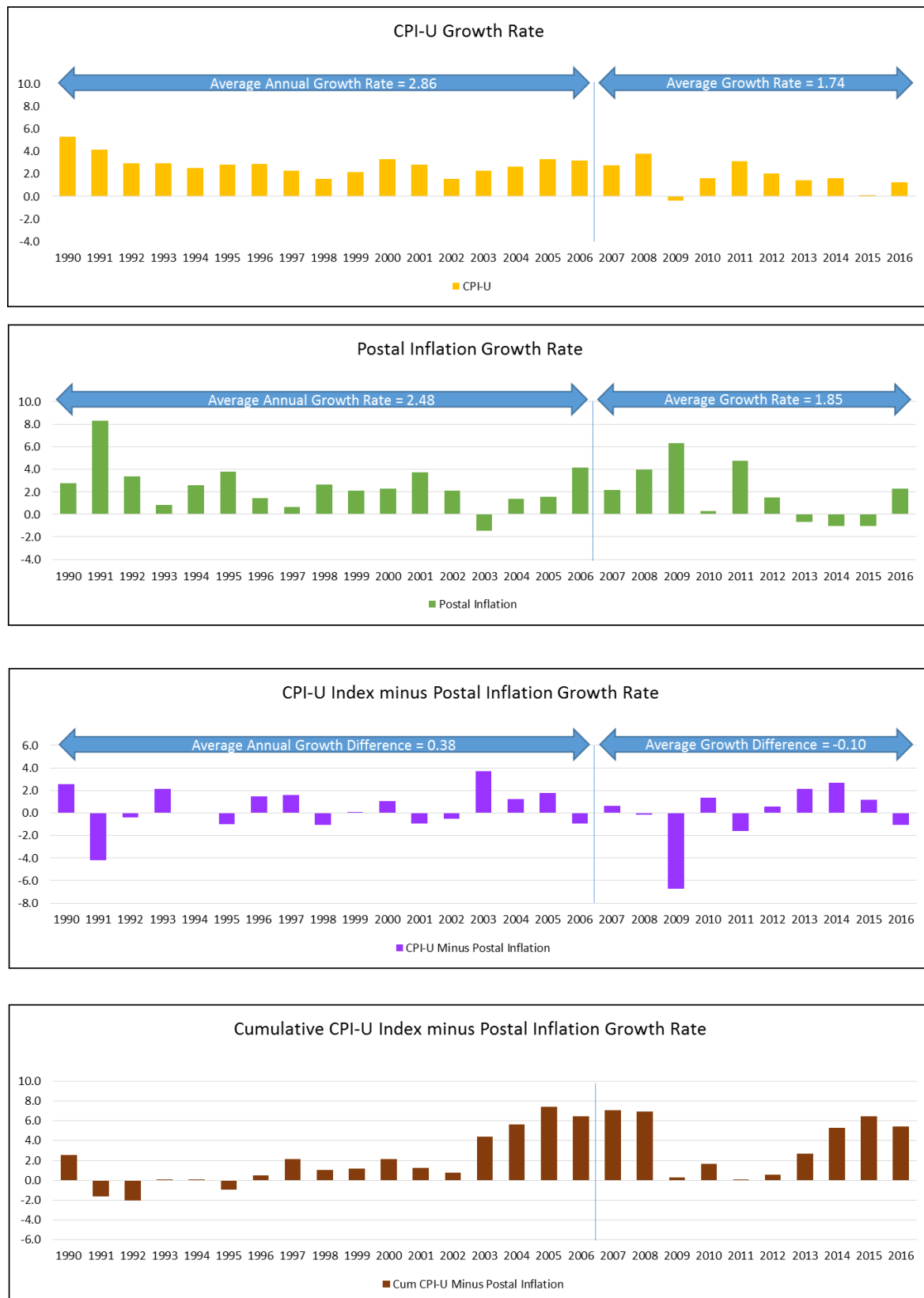


Figure 17: Growth Rates – Postal Inflation Index & CPI-U



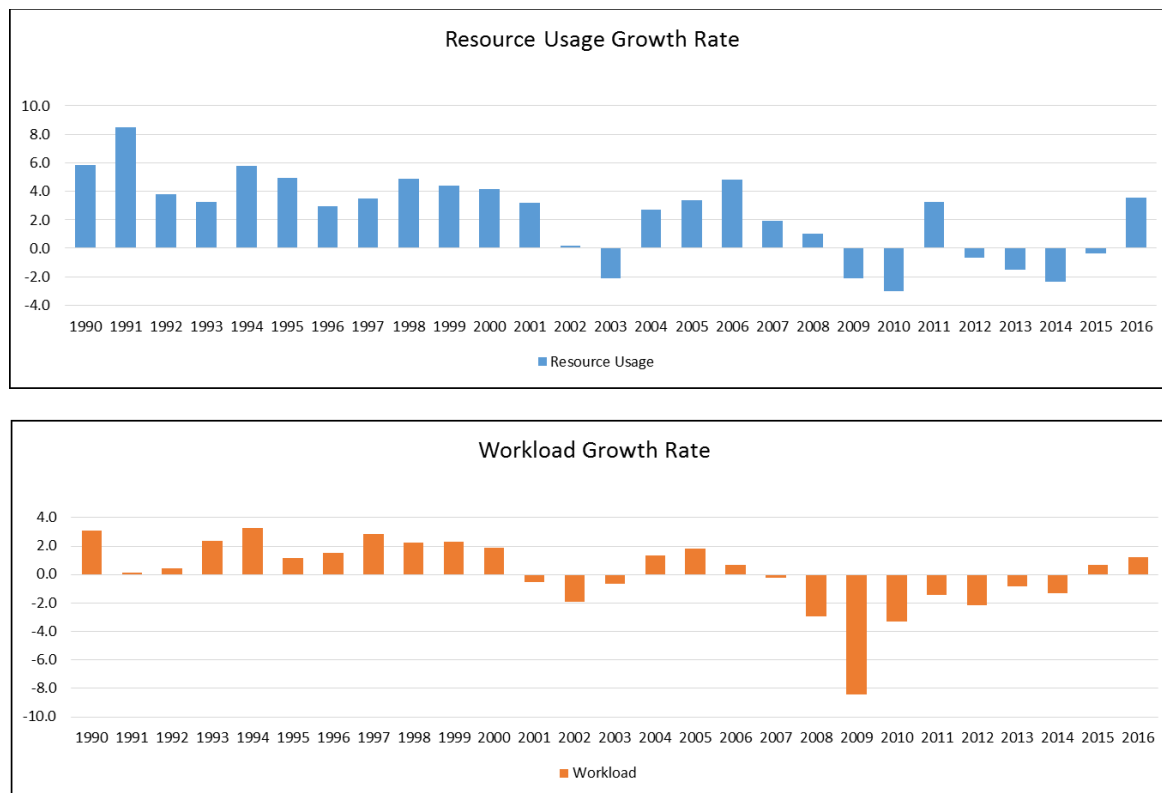


Figure 18: Postal Inflation Index

Year	Inflation Indexes				Growth Rates (%)			
	Resource Usage Index	Workload Index	Postal Inflation Index	CPI-U Index	Resource Usage	Workload	Postal Inflation	CPI-U
1990	1.000	1.000	1.000	1.000	5.81	3.08	2.73	5.26
1991	1.088	1.002	1.087	1.042	8.46	0.16	8.30	4.12
1992	1.131	1.006	1.124	1.073	3.81	0.45	3.36	2.97
1993	1.168	1.031	1.133	1.106	3.24	2.39	0.84	2.95
1994	1.237	1.064	1.162	1.134	5.80	3.24	2.55	2.53
1995	1.300	1.077	1.207	1.166	4.92	1.16	3.77	2.79
1996	1.339	1.093	1.225	1.200	2.96	1.50	1.46	2.91
1997	1.387	1.125	1.233	1.228	3.51	2.84	0.67	2.27
1998	1.456	1.150	1.266	1.247	4.87	2.25	2.63	1.55
1999	1.521	1.177	1.292	1.275	4.39	2.31	2.08	2.18
2000	1.586	1.199	1.322	1.318	4.15	1.87	2.28	3.31
2001	1.637	1.193	1.372	1.355	3.19	-0.53	3.72	2.81
2002	1.640	1.171	1.401	1.376	0.19	-1.89	2.08	1.57
2003	1.606	1.163	1.381	1.408	-2.09	-0.65	-1.44	2.25
2004	1.650	1.179	1.401	1.445	2.72	1.36	1.40	2.63
2005	1.707	1.200	1.423	1.494	3.39	1.81	1.58	3.33
2006	1.792	1.209	1.483	1.542	4.82	0.70	4.12	3.17
2007	1.826	1.206	1.515	1.586	1.92	-0.22	2.13	2.79
2008	1.845	1.171	1.576	1.647	0.99	-2.96	3.95	3.79
2009	1.806	1.076	1.679	1.641	-2.09	-8.43	6.34	-0.36
2010	1.752	1.041	1.683	1.668	-3.04	-3.31	0.27	1.63
2011	1.811	1.026	1.765	1.721	3.27	-1.46	4.73	3.11
2012	1.799	1.004	1.792	1.757	-0.66	-2.16	1.50	2.05
2013	1.772	0.996	1.780	1.782	-1.50	-0.83	-0.67	1.45
2014	1.731	0.983	1.761	1.811	-2.37	-1.31	-1.06	1.61
2015	1.724	0.990	1.743	1.813	-0.37	0.66	-1.04	0.12
2016	1.786	1.002	1.784	1.836	3.52	1.21	2.31	1.25

2. Growth Rates by Trend – Grouping of Years

The table below summarizes the growth rates for the metrics examined in this report. The results for the three primary TFP results indexes (the first three in the chart) have been presented in the previous section. This table also presents the growth rates for the results provided in the rest of the report. In particular, alternative productivity indicators and the components in TFP are provided.

Figure 19: Summary of TFP Process – Growth Rates

Summary of TFP Process - Growth Rates									
		Before PAEA			After PAEA			Before	After
		1990	1993	2001	2007	2010	2014	1990	2007
		1992	2000	2006	2009	2013	2016	2006	2016
Results Indexes									
1	Total Factor Productivity	0.52	0.34	1.33	0.05	1.54	0.04	0.72	0.64
2	Labor Productivity	1.43	1.23	1.83	0.80	1.92	0.71	1.48	1.22
3	Postal Inflation Index	4.80	2.03	1.91	4.14	1.46	0.07	2.48	1.85
4	Network (PDs) Productivity								
5	Total Input	0.68	-0.44	2.62	5.05	4.10	0.67	0.84	3.35
6	Labor	1.73	0.14	3.63	6.06	3.75	-0.58	1.65	3.14
7	Total Output Productivity								
8	Total Input	0.48	0.59	0.77	-2.09	0.45	-0.22	0.63	-0.51
9	Labor	1.38	1.48	1.28	-1.34	0.83	0.45	1.39	0.07
10	Total Output per Delivery	-0.20	1.03	-1.85	-7.14	-3.64	-0.88	-0.14	-3.86
11	Output per PD Productivity	-0.92	-0.74	-0.65	-3.21	-0.16	-1.04	-0.78	-1.34
12	Deliveries per Workhour	1.73	0.14	3.63	6.06	3.75	-1.74	1.65	3.14
Workload Components									
13	Workload	1.23	2.19	0.13	-3.87	-1.94	0.19	1.30	-1.88
14	Network (PDs)	1.39	1.42	1.43	1.13	0.61	0.82	1.42	0.83
15	Total Output	1.19	2.45	-0.42	-6.01	-3.03	-0.06	1.21	-3.03
16	Miscellaneous Output	1.01	1.37	3.50	0.17	-1.07	-3.89	2.06	-1.54
17	Weighted Mail Volume	1.20	2.50	-0.66	-6.51	-3.21	0.20	1.15	-3.18
18	First Class	0.84	1.64	-0.98	-5.10	-5.86	-2.56	0.56	-4.64
19	First Class Non-Presort	-1.71	-0.66	-3.61	-7.40	-8.89	-5.01	-1.88	-7.28
20	First Class Presort	5.71	4.91	1.58	-3.30	-3.85	-1.16	3.87	-2.88
21	Standard Mail	-0.47	5.16	2.68	-7.16	-3.70	-0.15	3.52	-3.67
22	Sort Preparation	0.18	6.03	3.42	-6.36	-4.94	1.88	4.08	-3.32
23	Carrier Preparation	-2.12	2.63	-0.04	-9.60	-0.31	-5.05	0.85	-4.52
24	Periodicals	-1.34	0.37	-2.28	-4.76	-5.37	-4.34	-0.87	-4.88
25	Package Services	9.16	4.77	0.78	-5.11	-8.24	-10.92	4.13	-8.10
26	Broad Package Category	6.16	6.83	-1.95	10.83	4.65	11.37	3.46	8.52
27	International	-4.60	0.93	-5.06	-1.99	-2.93	-4.88	-2.16	-3.23
Input Components									
28	Input Total	0.71	1.86	-1.20	-3.92	-3.48	0.15	0.58	-2.52
29	Labor Total	-0.19	0.97	-1.70	-4.67	-3.86	-0.52	-0.18	-3.10
30	Clerks / Mailhandlers	-1.25	0.89	-3.44	-8.42	-6.47	0.65	-1.02	-4.92
31	City Carriers	0.21	0.96	-1.14	-3.96	-2.43	-0.83	0.09	-2.41
32	Special Delivery	-6.32	-8.79						
33	Rural Carriers	3.00	3.80	1.90	-0.20	-0.28	1.78	2.99	0.37
34	Maintenance Service	1.95	2.36	-0.03	-2.38	-3.68	-1.05	1.45	-2.50
35	Vehicle Service	-0.72	1.75	0.64	-2.29	-1.03	2.19	0.92	-0.44
36	Postmasters	0.46	0.51	-0.36	-0.64	-1.26	-17.79	0.19	-6.03
37	Supervisors	-0.84	-1.36	-1.56	-4.97	-4.83	1.50	-1.34	-2.97
38	Admin / Technical	-0.11	1.01	-0.87	-6.30	-11.16	1.23	0.15	-5.99
39	Other Personnel	2.37	-0.65	-2.38	5.82	-8.78	-0.27	-0.73	-1.85
40	Materials								
41	Transportation	5.27	3.99	1.22	-1.57	-2.58	3.10	3.24	-0.58
42	Non-Transportation	6.44	5.64	-2.35	-3.92	-1.79	3.64	2.96	-0.80
43	Capital	5.42	6.07	3.60	2.71	-2.51	-1.33	5.08	-0.59

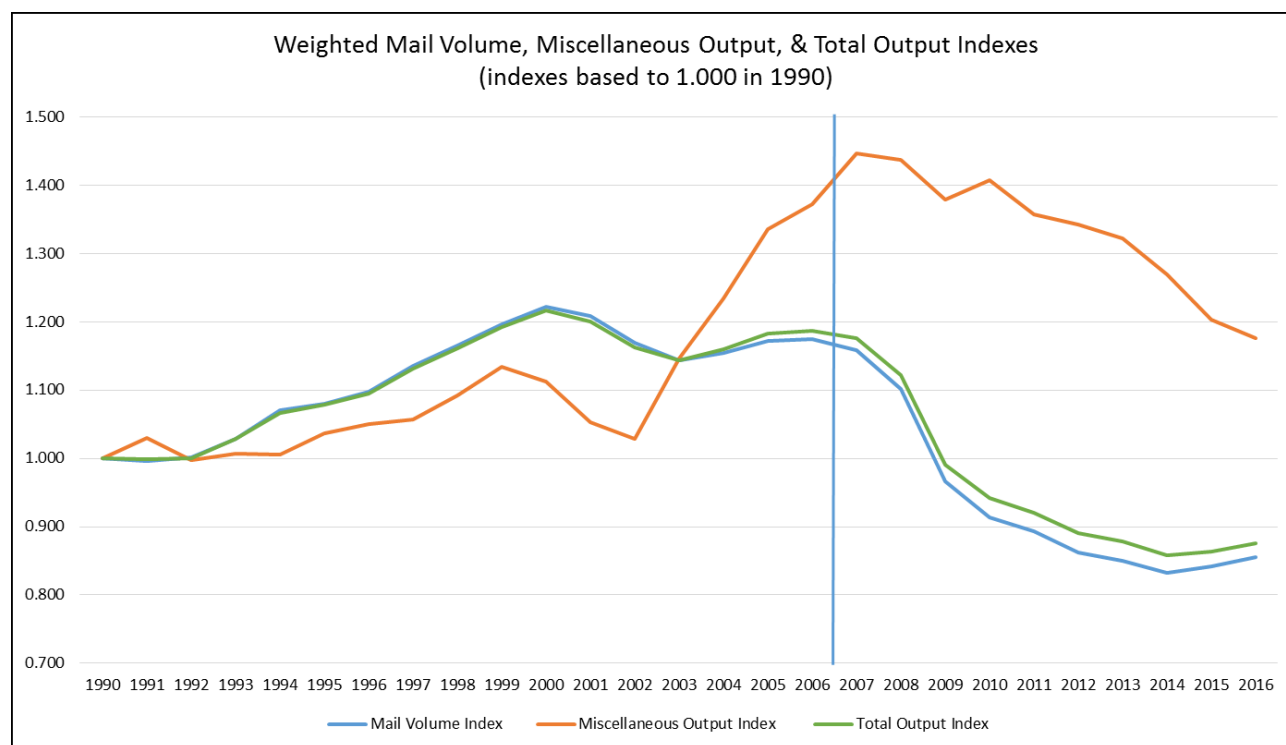
3. Productivity Results – Alternative Indicators

The analysis of alternative indicators provides useful insight into the productivity aspects of the Before and After PAEA periods. These alternative indicators primarily examine and segregate the components of Workload: Weighted Mail Volume, Miscellaneous Output, and Possible Deliveries (the delivery network). Later, there will be a review of productivity metrics that focus on various forms of delivery performance. The examination of these delivery-based metrics is relevant as the Postal Service uses Deliveries per Total Workhour (DPTWH) as their primary national productivity measurement. An alternative of Total Output per Delivery per Input is also examined. This alternative represents the average resources used to provide the average Output per Possible Delivery.

A. Total Output, Possible Deliveries (Network), & Combined Workload

Total Output is the combination of the Weighted Mail Volume and the Miscellaneous Output. These are combined using their respective share of the Attributable Cost. These indexes, reset with 1990 as the base year, are shown in Figure 20.

Figure 20: Weighted Mail Volume, Miscellaneous Output combine for Total Output Index



The weighting used to combine Weighted Mail Volume and Miscellaneous Output is provided in Report 1. It remained constantly around five percent in the 1990's. Military Mail Reimbursements and Delivery Confirmation growth appear to have caused the spike starting in 2002. The TFP Tables do not provide a complete history of the details for all categories of Miscellaneous Output. In general, Total Output close follows the weighted mail volume. Additional insight into the impact of presort, pricing, and other classification changes are shown the section on Output – Weighted Mail Volume.

Total Output is combined with Possible Deliveries (Network) using a weighting factor. This factor is based on cost elasticity models by Christensen Associates. The relationship between the Total Output, Possible Deliveries (Network) is correlated to Resources (Input – Labor, Materials, and Capital). The cost elasticity factor is used to weight the Total Output and Network to create the composite Workload.

In simple terms, a regression analysis is used to determine the factor based on the historical relationship of Weighted Mail Volume, Miscellaneous Output, and Possible Deliveries to total Resources used.

This factor has changed three times over the history of TFP. It was just changed in 2016. Christensen Associates provided the following explanation for the changes to the factor.

The model is re-estimated each year, with the additional year's information included in the analysis. To maintain stability in the TFP estimates, we only change the cost elasticities when there is conclusive evidence that the elasticities should be changed, and we only change them going forward.

At the time that the paper was published, the estimated output cost elasticity was 0.788. During the mid-1990s, our annual updating of the econometric model produced somewhat reduced cost elasticities for output, eventually stabilizing around 0.7. In 1998 we began using the 0.7 estimate for computing workload.

The econometric model regularly produced an output cost elasticity around 0.7 up until 2009, when the cost elasticity estimate was reduced. In recent years, it has stabilized around 0.63. Consequently, we started using the elasticity estimate of 0.63 beginning in FY 2016. The elasticity has changed over time, but the methodology has been consistent.

The full explanation is documented in Appendix 2 – TFP Reference Materials.

The Total Output, Network (Possible Deliveries) and Workload are shown in Figure 21 and Figure 22.

Figure 21: Total Output, Network, and Resulting Workload Indexes, 1972 to 2016

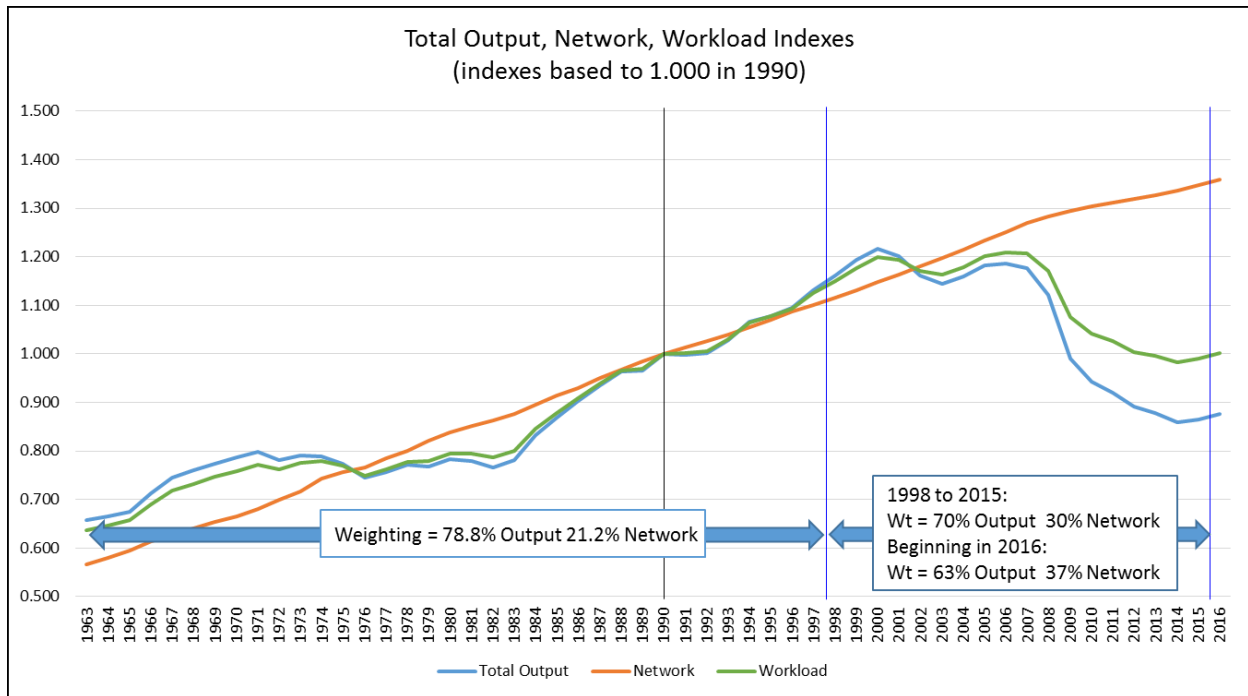
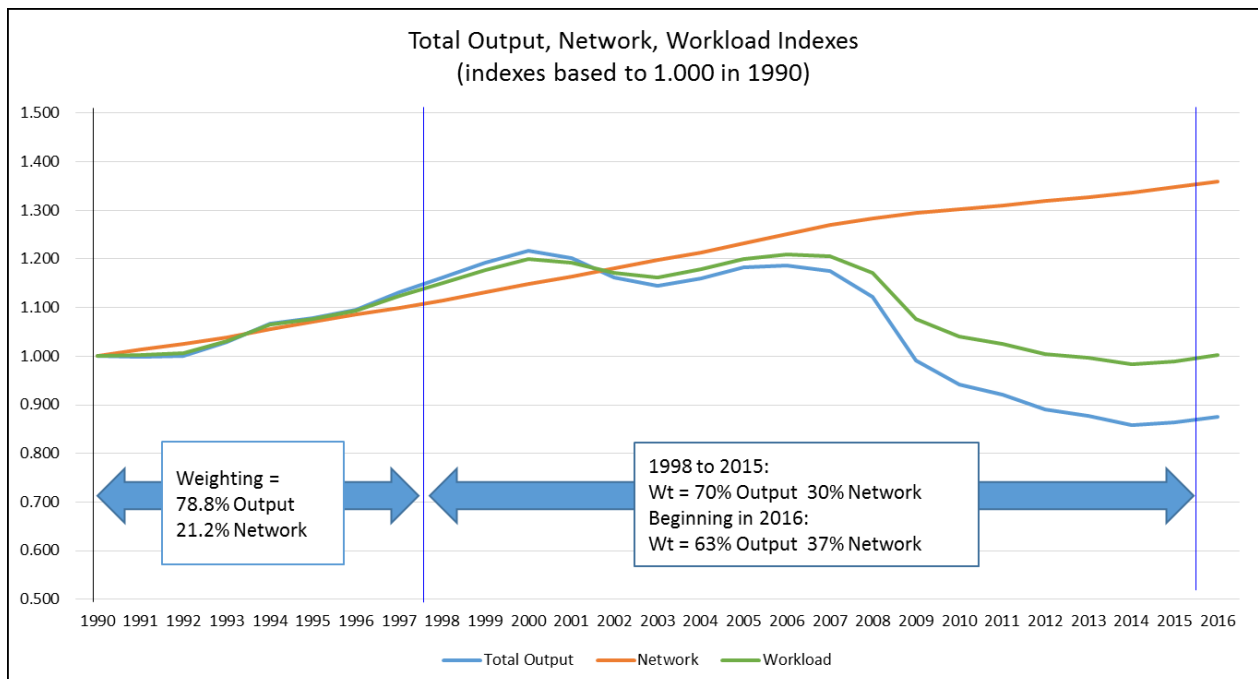


Figure 22: Total Output, Network, and Resulting Workload Indexes, 1990 Base Year



This approach to using the historical relationship leads to consistent results up until the Great Recession and resulting volume drop starting in 2007. Electronic Diversion had already started to have an impact on mail volume starting in 2000. But the relationship between Volume and Possible Deliveries change dramatically starting in 2007. As noted by Christensen, they observed the change in starting in 2009, but did not change the factor until 2016. Results are not recast.

In general, the Attributable Costs used in the model are the Volume Variable components of the CRA. The concept of “output” using Total Output (mail volume and miscellaneous output) for the numerator of a productivity calculation is straight-forward. Accounting for the “output”, or numerator, to use to reflect the delivery network obligation is less straight-forward. TFP uses the historical relationship to combine the two aspects of “output” into the Workload Index.

When this relationship dramatically changed in the After PAEA period, it is appropriate to examine the aspects of productivity based on Total Output, i.e., mail volume, versus productivity based on just possible deliveries, and a combined metric.

This is fundamentally the question of “Is TFP accurate and appropriate?” Report 1 documented that TFP is accurate from a methodology standpoint. As to if it is appropriate, that depends on how the work content of the delivery network is weighed against the work content of mail volume.

In order to understand the relationship of the network weighting factor, the NWPC TFP Model was used to create the range of Workload results based on increments of the weighting factor. Figure 23 shows the published results of the Total Output, Possible Deliveries (Network) and resulting Workload in the bold lines. The Workload is then calculated in increments of ten (10) percent. This shows where Workload would be if that value were held constant over the 27-year period (1990 to present).

The analysis shows that the weighting has only a moderate effect prior to 2007. Once the volume drops, the workload result diverges significantly from the published Workload.

This analysis is then applied to the calculation of TFP and shown in Figure 24. The resulting TFP value diverges significantly starting in 2008 as the historical relationship between possible deliveries and mail volume changes.

Figure 23: Workload result based on different Total Output to PDs Weighting

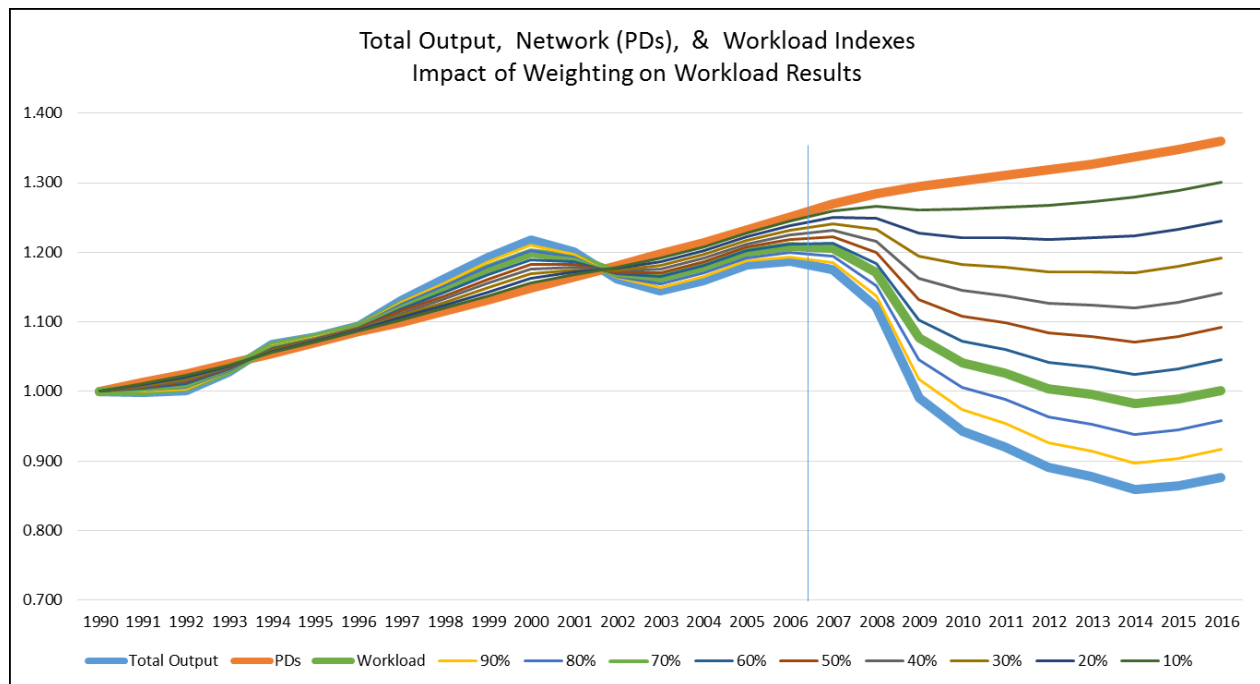
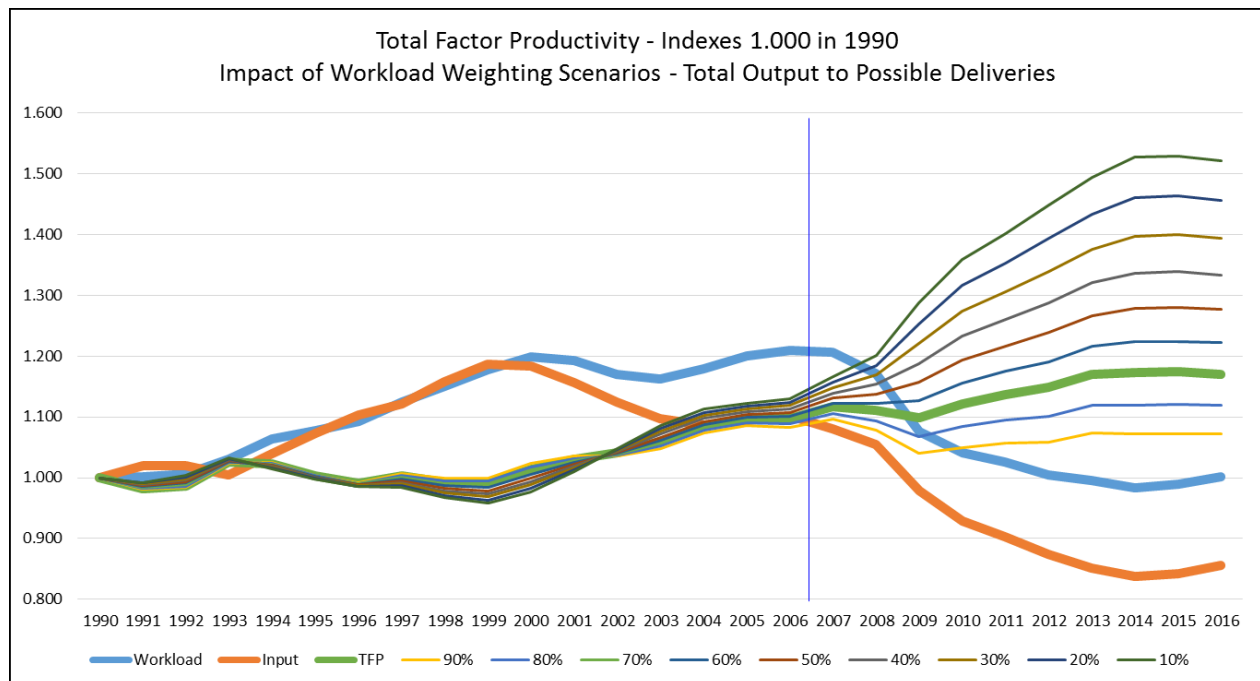


Figure 24: TFP Result based on different Total Output to PDs Weighting



B. Alternative Methodology using Yearly CRA for Weighting Factor

TFP is considered an appropriate productivity measure because it considers all aspects of workload. The issue of accuracy is more complex as it must consider the precise relationship of the two workload aspects. The question of accuracy becomes an assessment of the precise relationship between the output aspect of weighted mail volume and miscellaneous output versus the network tasked with serving an increasing number of delivery points. Varying that relationship (i.e., weighting value) between Total Output and Network (PDs) can yield different results. Thus, the appropriateness of the result is tied to the accuracy of the weighting factor.

The current TFP methodology uses the historical relationship of network against Total Resource usage. If the cost elasticity of adding possible deliveries should result in a credit 37% to the productivity numerator for Possible Delivery growth, then the result is appropriate and accurate. However, if the work content associated with adding possible deliveries is not 37% of the cost, then the results lead to a different assessment of productivity. In general, the cost elasticity concept is that if the metric increases or decreases, the elasticity is the resulting cost directly associated with that change.

With that in mind, one potential way of looking at the network factor is to examine the CRA. The Attributable Cost portion of the CRA is already a foundation of Total Output with mail volumes and Miscellaneous Output, using that data for weighting the two components.

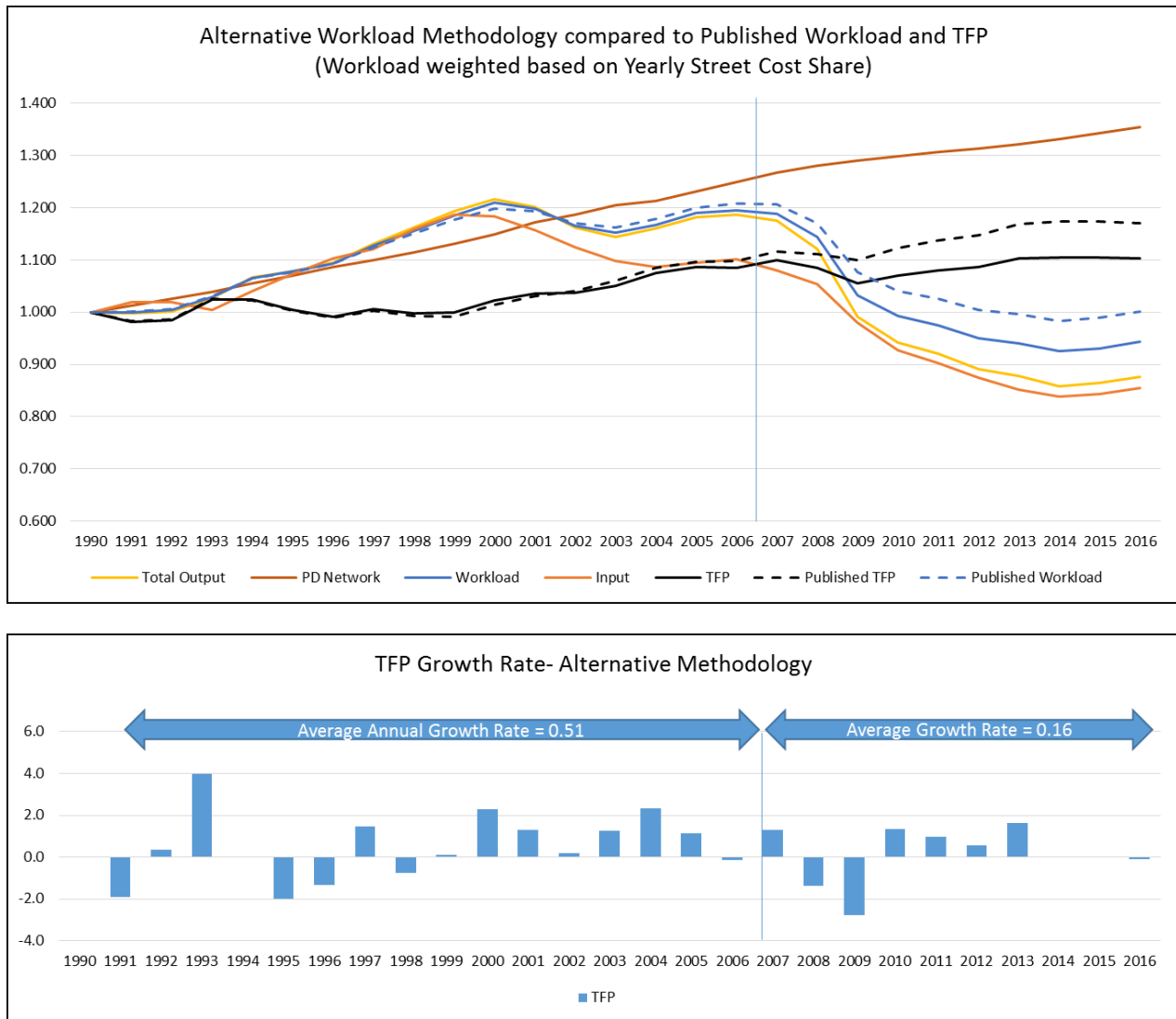
The CRA does provide the fixed cost of street delivery for City and Rural delivery as Other or Institutional Costs. This interpretation is that the Volume Variable component represents the mail volume component and the Other Costs represents the fixed cost of delivery. In simple terms, at zero volume, the Other Cost would still be incurred for the delivery network.

This data could be used as a basis for a methodology to calculate the weighting directly from the CRA on an annual basis. Effectively, the percentage of this fixed delivery cost to the total attributable costs could provide a weighting factor for the delivery network.

The attributable cost of fixed street delivery is calculated on a yearly basis and used as the weighting factor. This approach establishes the relationship of all three components in the ACR for that year. It starts in 1990 with the weighting at 11%. The factor then increase each year as the fixed street portion increases as a percentage of total Attributable Cost. The factor is 19.2% in 2016.

Appendix 4 – Alternative Methodology for Workload Weighting provides the methodology used to calculate this weighting factor.

Figure 25: Alternative Workload Methodology – Yearly Calculation of Weight based on Street Cost



The result as displayed in Figure 25 shows that TFP would still follow the trend of the Published TFP result, but would have a lower value when the volume drops in 2007. This method reacts in a yearly manner to the relationship of volume to deliveries based on the CRA results.

C. Productivity Indicators based on Delivery Point Orientation

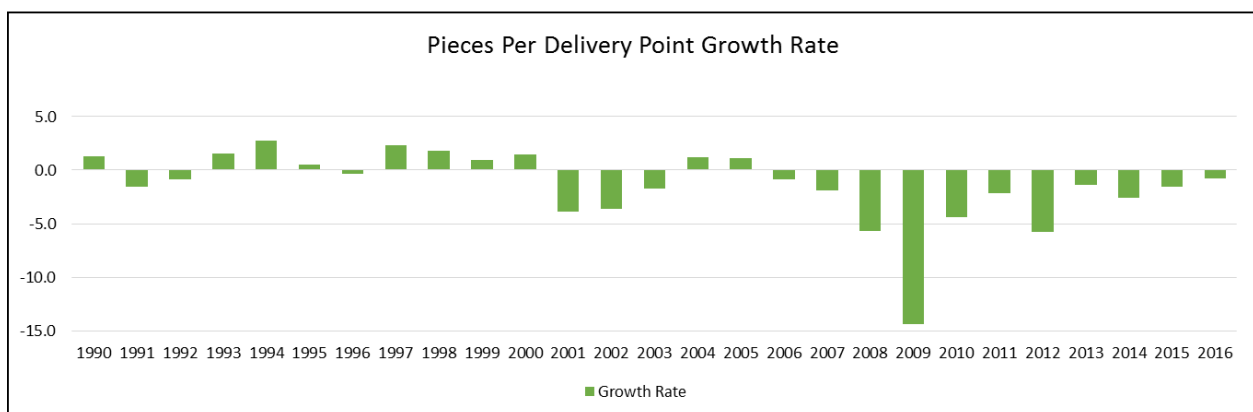
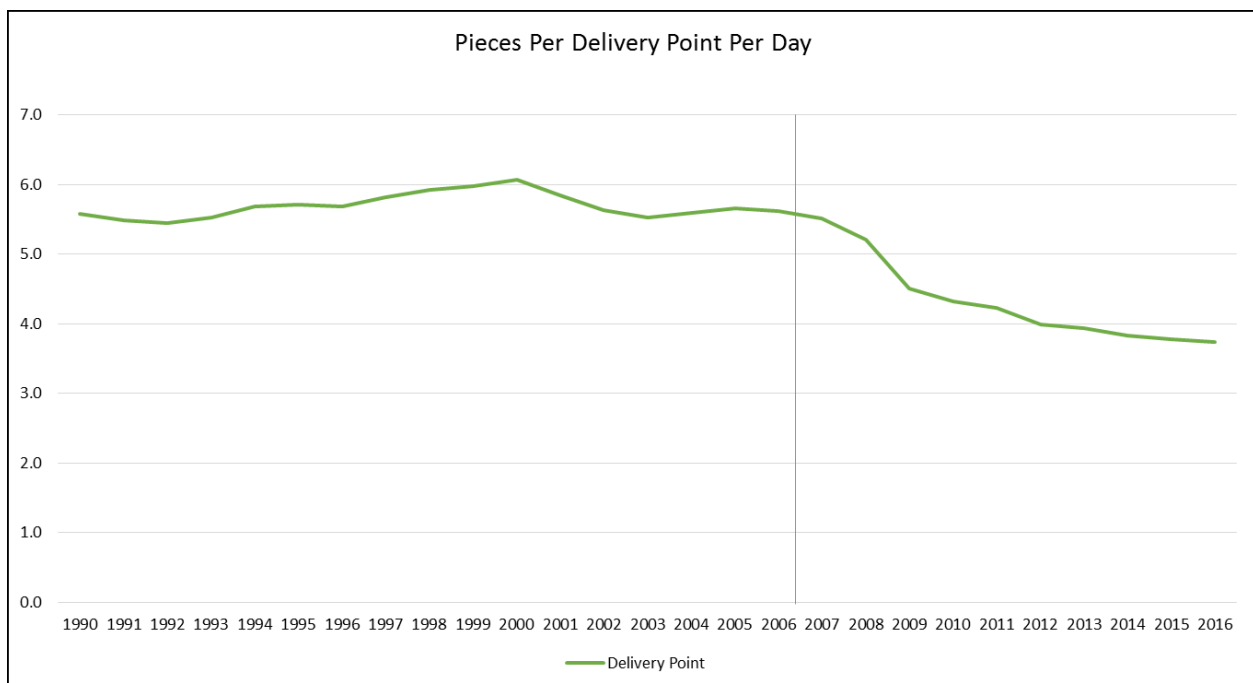
This section will look at alternative productivity calculations based on segregating the Total Output from the Possible Delivery as the numerator in the productivity equation.

The determination of the effectiveness the TFP results would benefit from having alternative productivity measures for comparison. The Postal Service has used Deliveries per Total Workhour (DPH), more recently termed DPTWH, for their national productivity measurement. In fact, the Postal Service has replaced TFP with DPTWH as their primary national productivity indicator for planning purposes.

While DPTWH does have some merits, it does not include several of the key features of a TFP-based measurement. For instance, DPTWH does not include Materials or Capital impacts on inputs. It does not directly factor in the influence of changes in weighted mail volume or Miscellaneous Output. Also, DPTWH does not reflect the recent significant substitution of non-career employee use (at a lower wage rate) for career employees in Clerk / Mail Handler and City Carrier operations.

As a baseline for delivery point productivity measures, the historical pieces per delivery per day are shown in Figure 26. As expected, this reflects the long trend of fewer pieces per delivery that started in 1999. Electronic diversion, both in First Class Mail and Standard Mail, are a primary cause of this downward trend. The 2008 Recession period exacerbated the rate of decline.

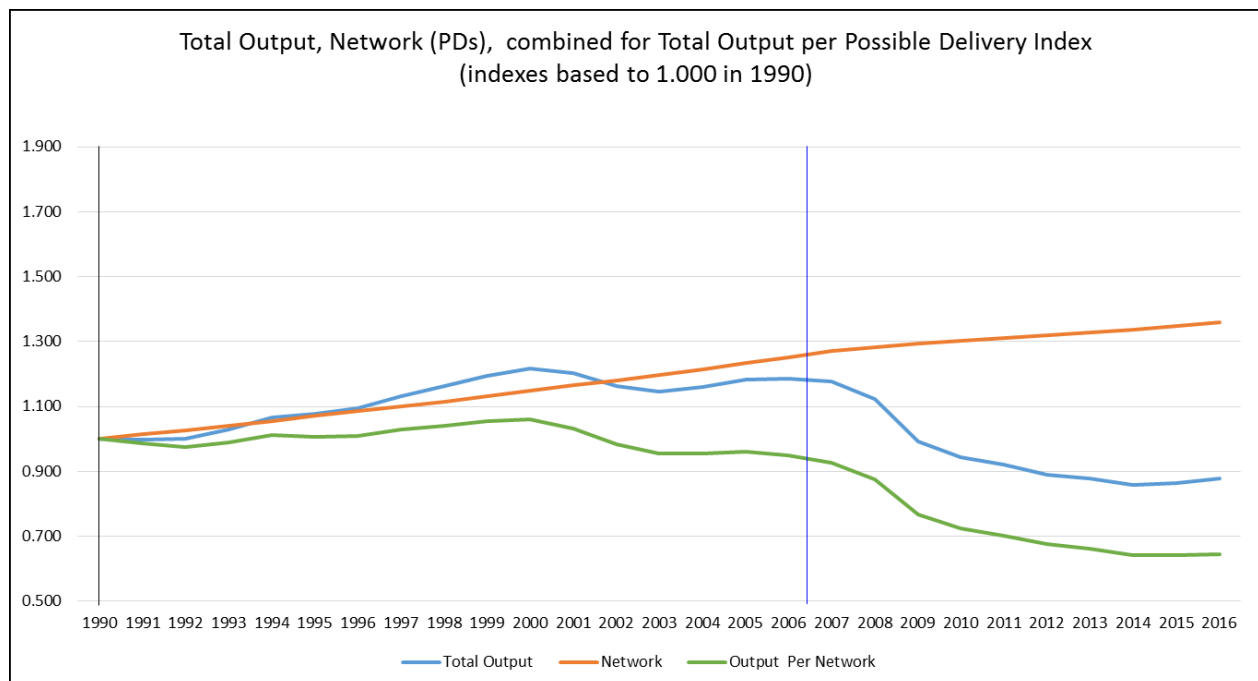
Figure 26: Pieces per Delivery Point per Day



The TFP methodology calculates Weighted Mail Volume. This is combined with Miscellaneous Output to create Total Output. Figure 27 shows the “Total Output per Possible Delivery” using the TFP components. It is an index as opposed to a number of actual mail pieces.

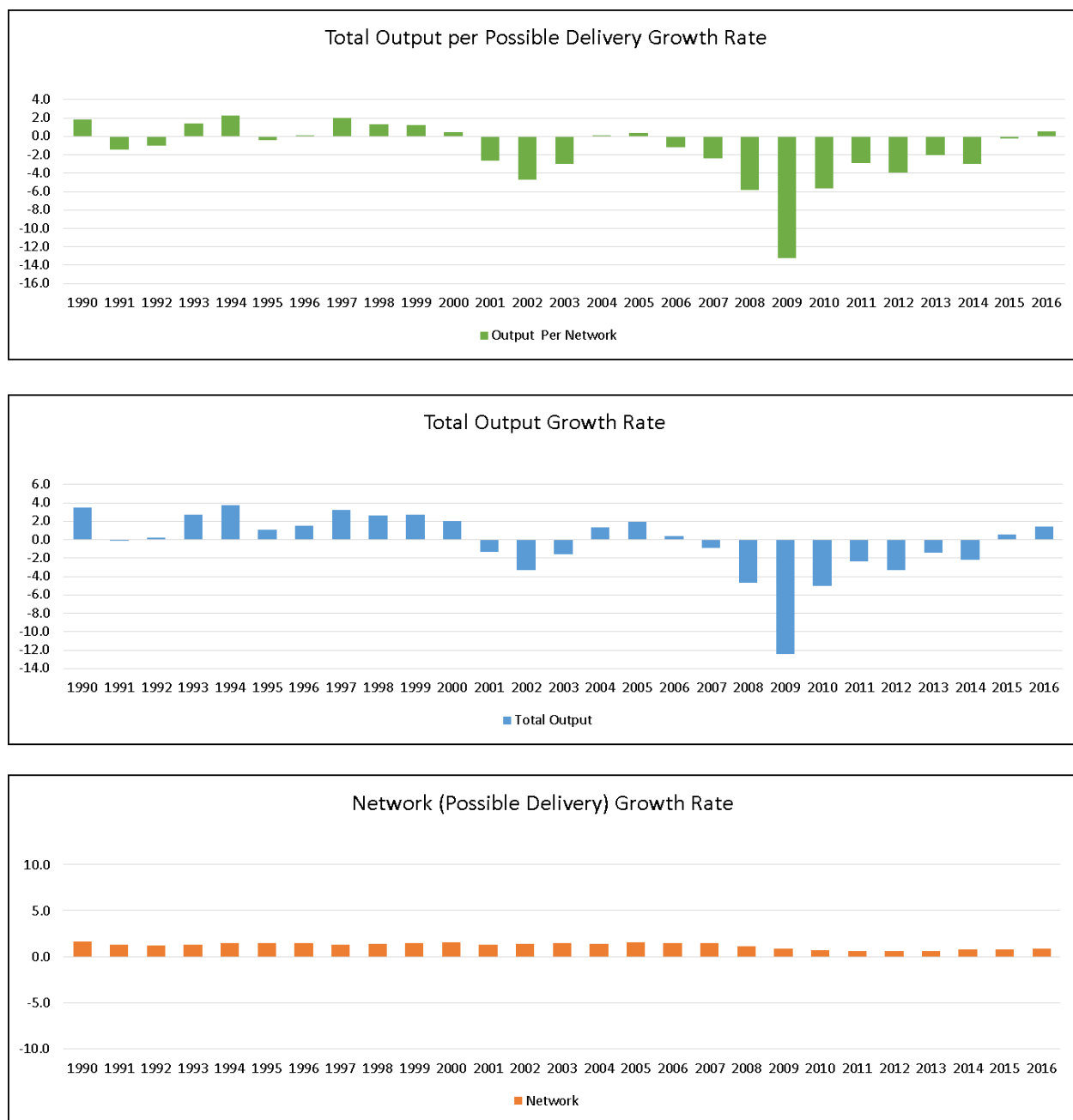
This result could be considered a type of Workload indicator, as it reflects the average Total Output per Delivery, merging the trend to fewer pieces with the growing possible deliveries. Figure 28 shows the growth rates.

Figure 27: Total Output per Possible Delivery Index



- The network shown in the orange line grows in a slow and relatively steady rate.
- Total Output is depicted in the blue line
 - It grows until 2000 until the recession, electronic diversion, and the anthrax attack drove it down.
 - After a mild recovery from 2003-2007, Total Output declines even more rapidly with the Great Recession of 2008 and the growing electronic diversion.
- Output per Network mimics the Total Output trend.
- Output per Network also matches the traditional Pieces per Delivery Point per Day trend line.

Figure 28: Growth Rates for Total Output per Possible Delivery Index



The Postal Service uses Deliveries per Total Workhour (DPTWH) as their national productivity measurement. Figure 29 shows this index using the TFP database.

Figure 29: Deliveries per Total Workhours

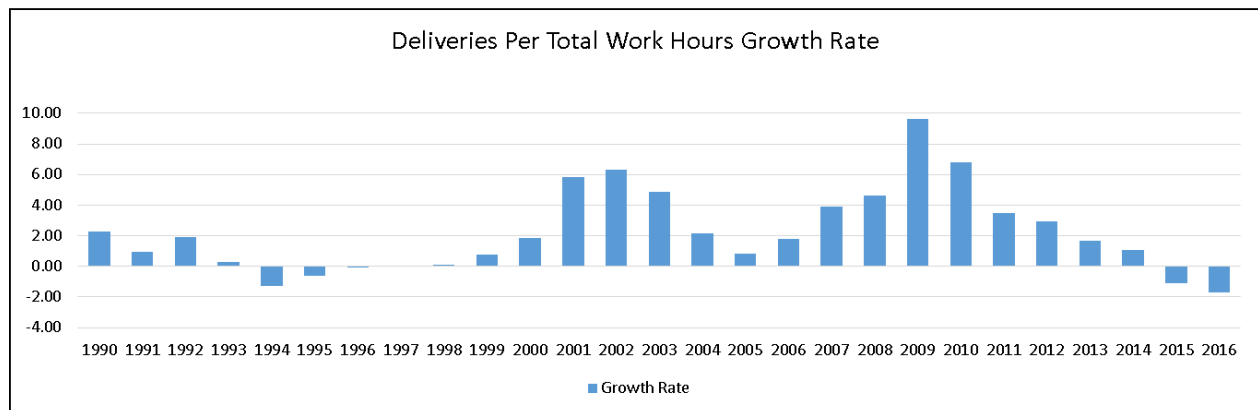
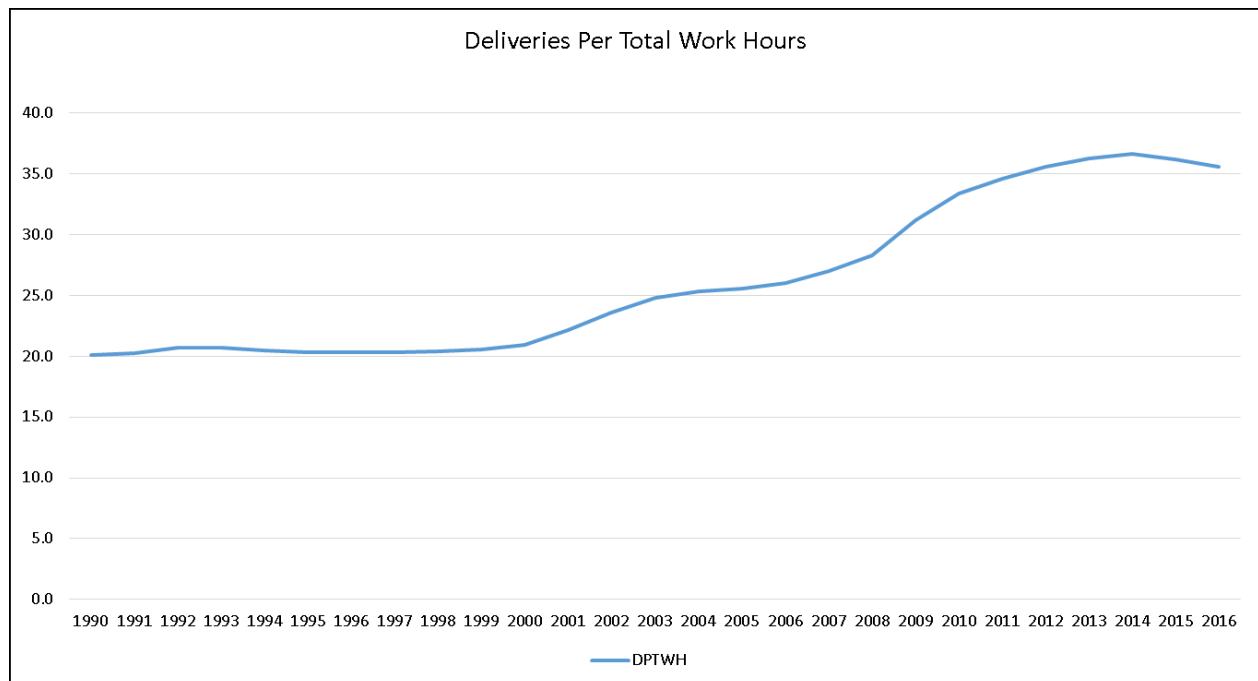
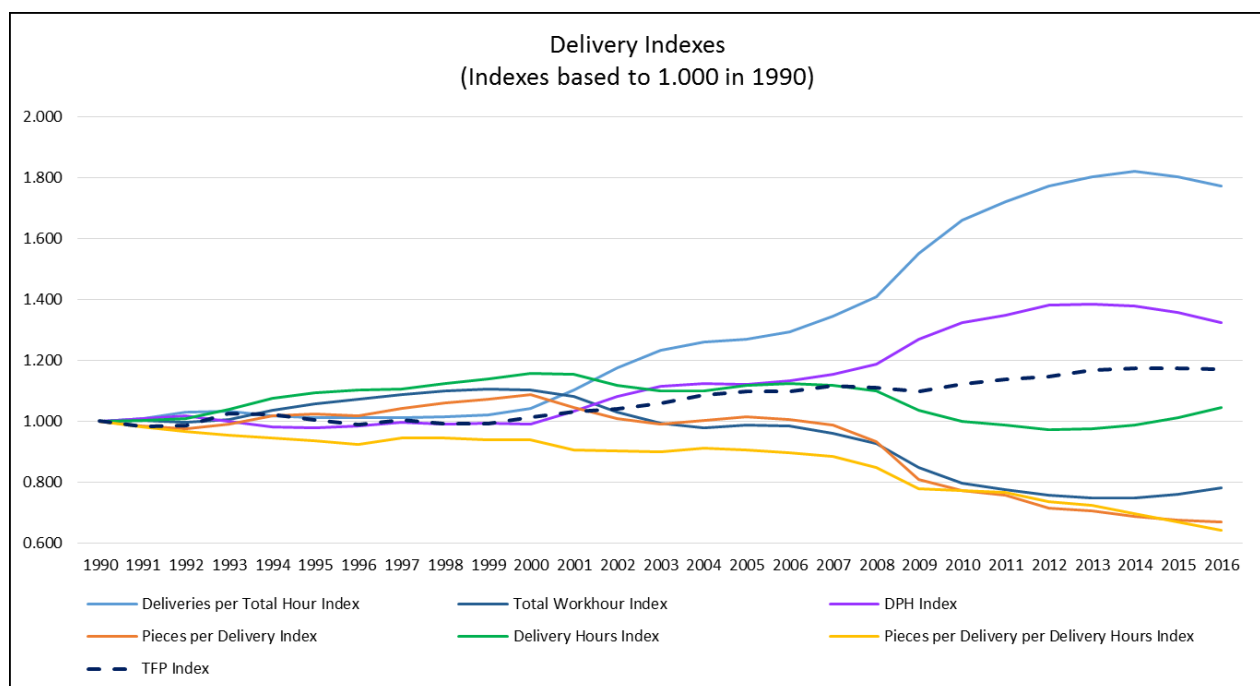


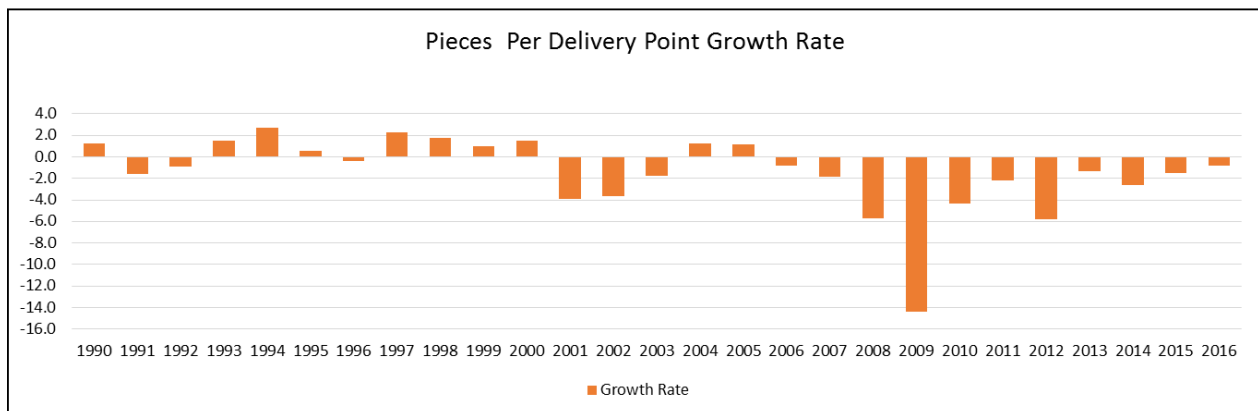
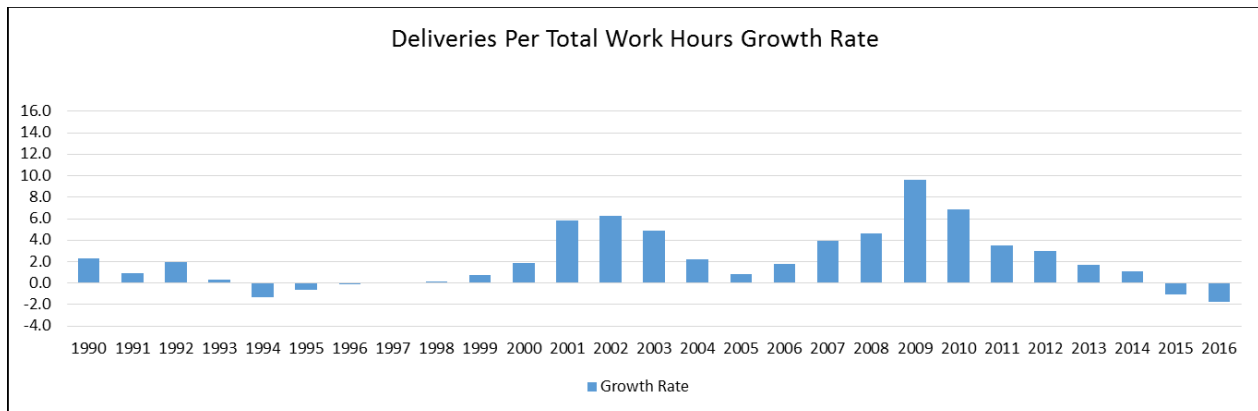
Figure 30 compares several different delivery based productivity metrics with TFP.

- The piece per delivery index, shown in yellow, declines over the entire 27-year period.
- This does not include any workhour adjustments that the Postal Service has started adding to reflect volume influences.
- It does not reflect the PO Boxes that are included in the USPS Deliveries per Total Hours performance metric.

- The “pieces per delivery per delivery hour” is a new metric. This would measure the hours used in delivery for the average pieces per delivery as an output numerator in the productivity equation. However, this approach can distort the result in a true productivity metric. For example, if volume went up and deliveries went up the same percentage, the average pieces per delivery hour would remain unchanged. However, it is reasonable that more hours would be used for to handle this growth, leading to a decline in the index. This metric illustrates the problem with using an average ratio as a metric rather than a direct workload metric.
- TFP is shown in the dashed line as a basis for comparison.
- This shows both Deliveries per Hour against Total Hours and against just Carrier Hours (City & Rural).
- Deliveries per Total Hour growth was flat for most of the 1990s.
- It started growing in the 2000’s and took off from 2008 to 2014, as the volume drop reduced hours. The Postal Service did effectively manage delivery costs and possible delivery growth during this period.
- Pieces per Delivery, per Hour is shown in dark yellow. It declines since 1990, then more rapidly since 2008.
- Pieces per Delivery continue to decline due to electronic diversion of First Class.

Figure 30: Delivery Productivity Indexes & Growth Rates





D. Comparison of Alternatives using Total Input

There are four productivity metrics that can be used in the numerator of the productivity equation:

1. Total Output: This measure excludes the Network and uses only the combination of Weighted Mail Volume and Miscellaneous Output (primarily Special Services), as Total Output, as the numerator.
2. Network: This metric uses only Possible Deliveries as the numerator.
3. Workload: The combination of Total Output and Network (workload) is the current numerator in TFP.
4. Total Output per Delivery: This metric divides the Total Output by the Network to reflect the average work content per delivery point. As a ratio, the result can be misleading, as true work content could go up or down while leaving the ratio unchanged. Total Output per Delivery is included to accompany the analysis of the first three metrics rather than as consideration as a single metric.

These four metrics, along with their component indexes, are shown in Figure 31. These metrics use the Total Input (Labor, Capital, and Materials) as the denominator of the calculation. These results support the following observations on Before and After PAEA productivity:

1. Possible Deliveries (Network) show linear constant growth, with a slowing in the rate after the Recession.
2. Total Output dropped significantly at the Recession in 2008. This followed a drop due to electronic diversion starting in 2000 (coupled with a recession along with the anthrax attacks in 2001), but had leveled out for the mid-2000's before the recession. Output declined slowly after the Recession, but has started to grow again in the past two years.
3. Input (Labor, Materials, and Capital) closely matched Total Output through the 1990's. In 2000, Input dropped faster than Total Output, leading to strong productivity growth. After the Recession, the Input has closely matched Output.

The following observations of the data in Figure 31 are provided in the following points.

1. The relationship of Total Output to Input can indicate how closely volume changes are matched in resource use.
 - a. In the 1990's, Total Output closely follows Input, leading to slight TFP increases.
 - b. In the 2000's, Input drops much faster than Total Output, leading to significant productivity increases. This appears to be related to the automation program maturing and leading to real savings, especially in delivery operations as DPS matures.
 - c. After the volume drop due to the Great Recession and electronic diversion, Input (resources) closely match Total Output. This leads to flat Output Productivity from 2009 through 2016. It also appears that delivery growth was, to a large part, absorbed in this period.

2. The Network (Possible Deliveries) productivity, the Red line, shows productivity as solely based on Possible Deliveries. It ignores the volume aspect.
 - a. This metric showed little or no productivity increases in the 90's.
 - b. The impact of automation and DPS can be seen with slow, consistent increases in the early 2000's. This is seen in the declining Clerk/Mailhandler index and the flat City Carrier labor index.
 - c. The productivity increases accelerate in TFP from 2010-2013. This is more a result of the reduction in resources due to reduced volume than to improvements in delivery. The Postal Service did effectively manage delivery costs and possible delivery growth during this period.
 - d. Network productivity flattens out and actually decline from 2014 forward. This is likely related to the increase in volume, primarily driven by eCommerce (i.e., parcel growth).
3. TFP falls between the Network and the Total Output productivity performance. As discussed in previous sections, TFP is dependent on the weighting factor between these two components of Workload.
 - a. TFP grows slowly in the 1990s, with automation absorbing the volume growth.
 - b. TFP increases are high in the 2000's up to the maturing automation and associated savings capture in mail processing and delivery operations.
 - c. After a drop during the Great Recession, TFP increases then flattens out.
4. Total Output (volume) per Delivery (light blue line) per Input is used as productivity metric for discussion.
 - a. Since 1993, this metric shows a gradual constant decline as output per delivery declines with the decrease in output and gradual increase in delivery points.

Figure 31: Comparison of Productivity Index Alternatives

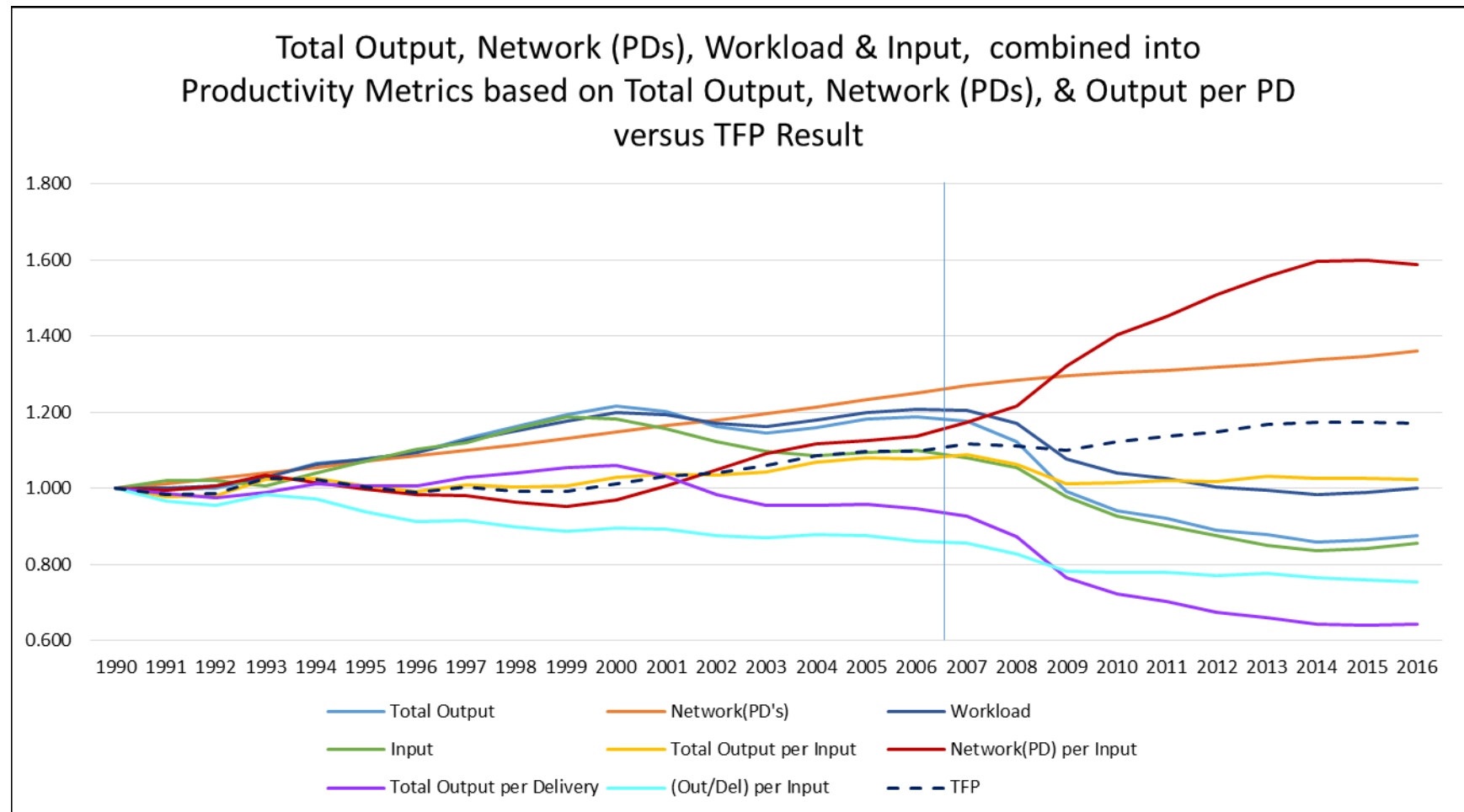
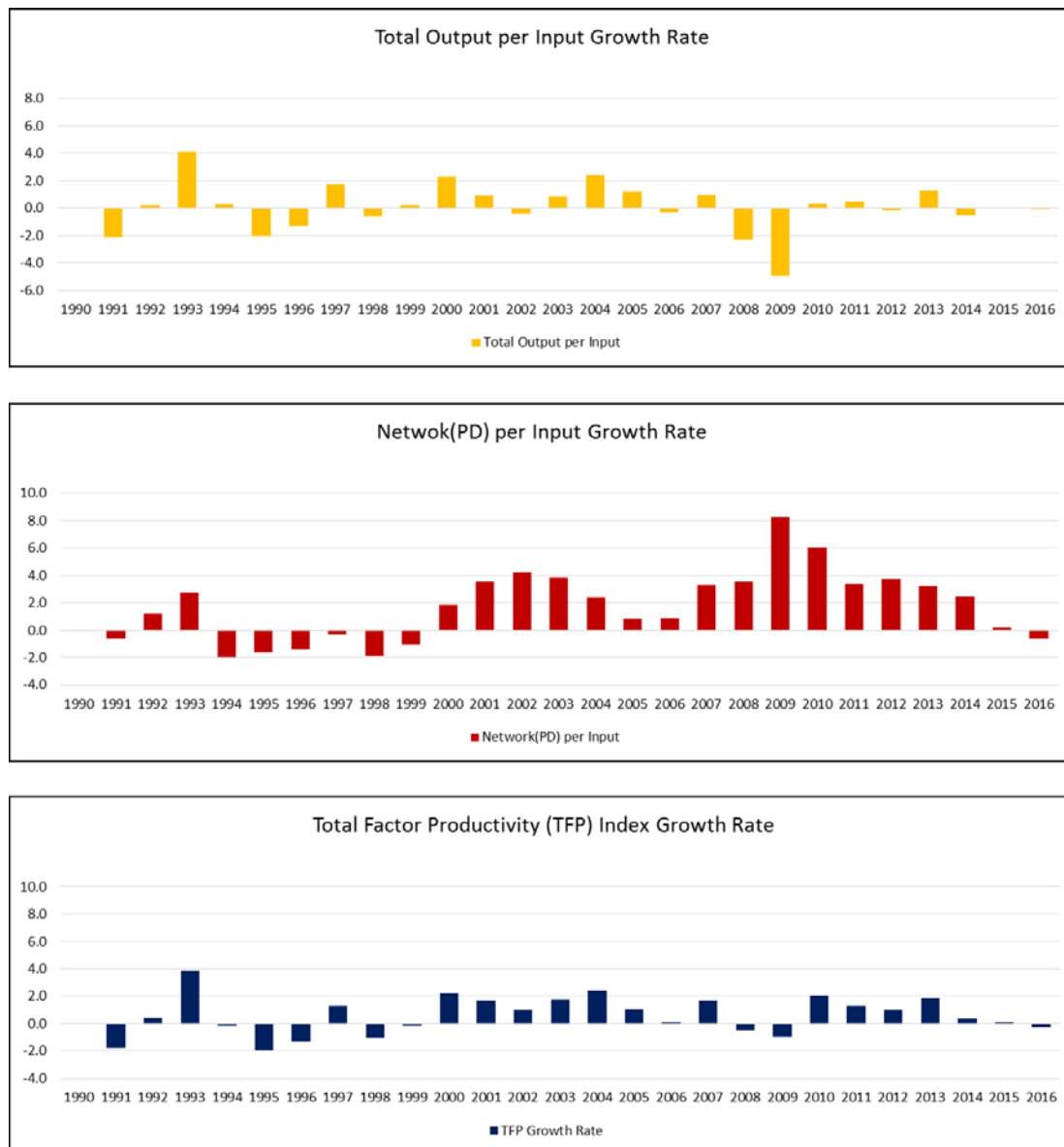


Figure 32: Growth Rates



Figure 33: Growth Rates

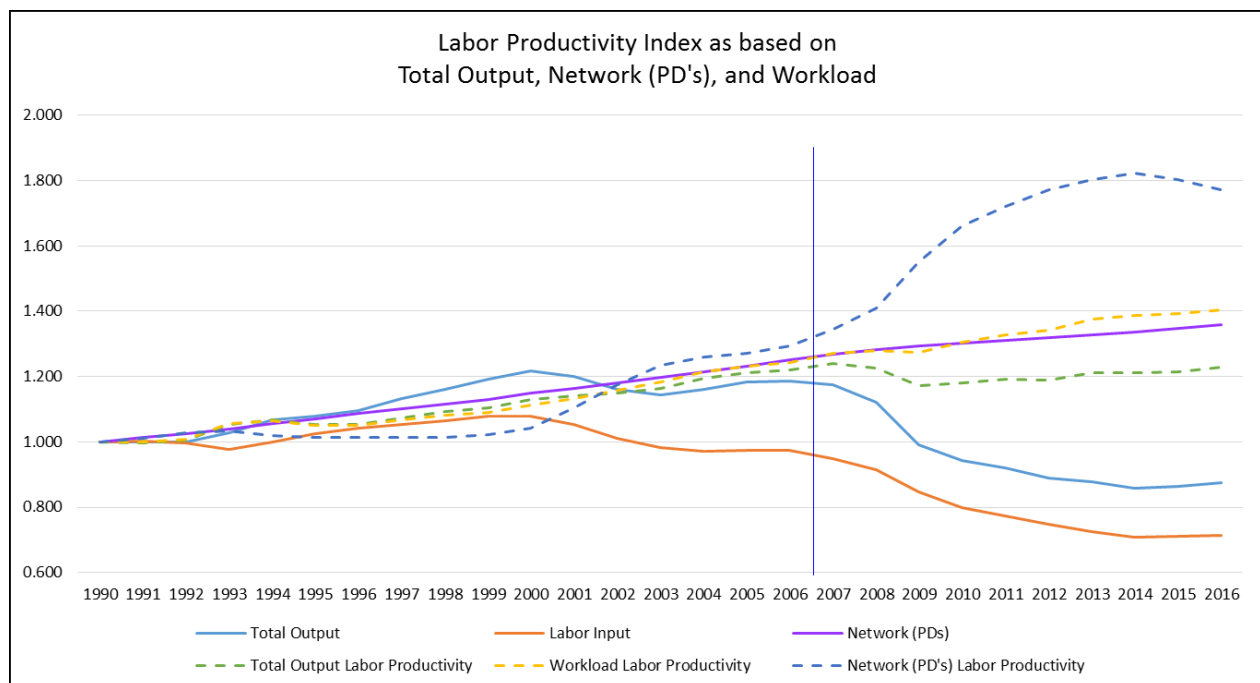


E. Productivity Metric Alternatives using Labor Only

Figure 34 examines productivity using only Labor against Total Output & Network (Possible Deliveries) as compared to the published Labor Productivity Index (Workload based). Several observations are worth noting.

- Labor Input (orange line) drops faster than Total Output (blue line) until 2009, leading to productivity increases in the labor index based on total output (dashed green line).
- Labor use closely matched the Total Output starting in 2009. It could be inferred that cost control strategies were very successful in matching labor to the volume changes during this period.
- The volume drop in 2008 flattens out improvement with labor matching volume decline.
- Deliveries per Hour (dashed blue line) show high growth between 2008 and 2014 because volume reduction means fewer labor hours, particularly in mail processing operations.

Figure 34: Labor Productivity Index – Using Total Output, Possible Deliveries, and Workload



F. Bureau of Labor Statistics Indicators

The Bureau of Labor Statistics (BLS) tracks Postal Service productivity as a single sub-index in the Transportation and Warehousing sector. The following three graphs compare the TFP Labor Productivity Index results against the BLS results. Note that the base year is set to 2007 to follow the BLS methodology.

The results track fairly closely until the recession in 2008. There is little specific information readily available about the BLS data sources and methodology. It is included here as a comparison to publicly available Postal Service productivity results.

Figure 35: Comparison of TFP and BLS – Hour Indexes

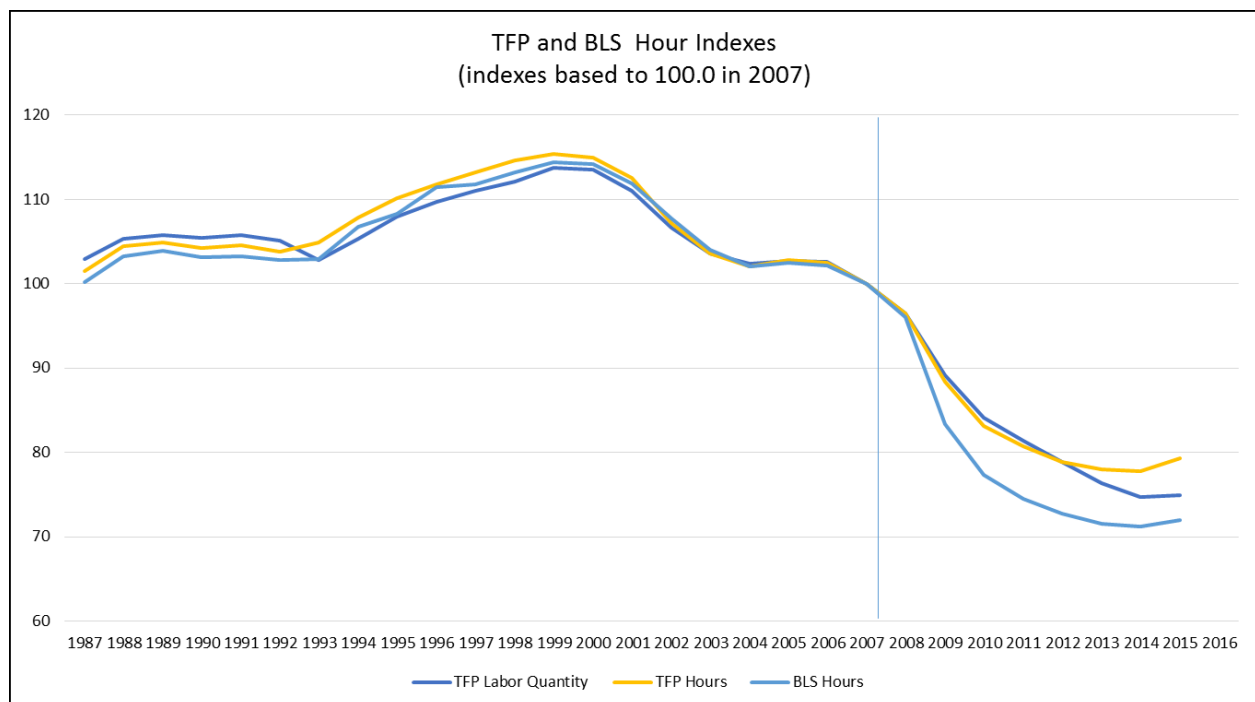


Figure 36: Comparison of TFP and BLS –Workload Indexes

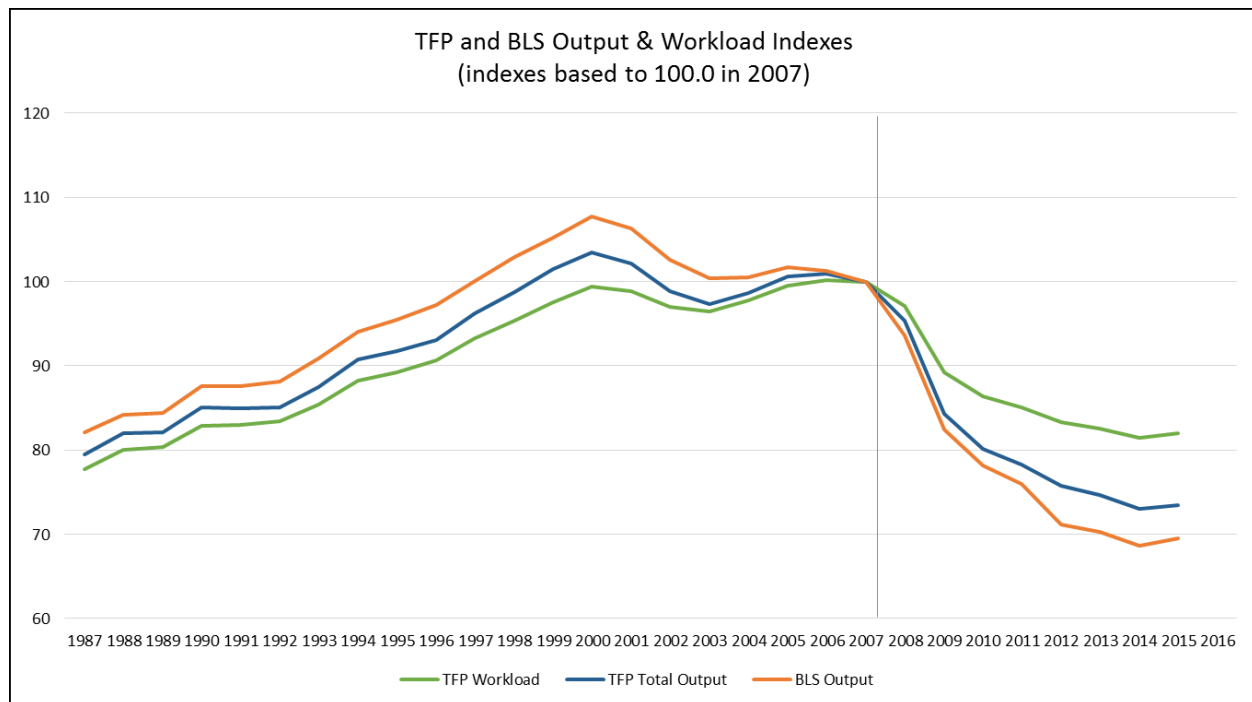


Figure 37: Comparison of TFP and BLS – Productivity Indexes

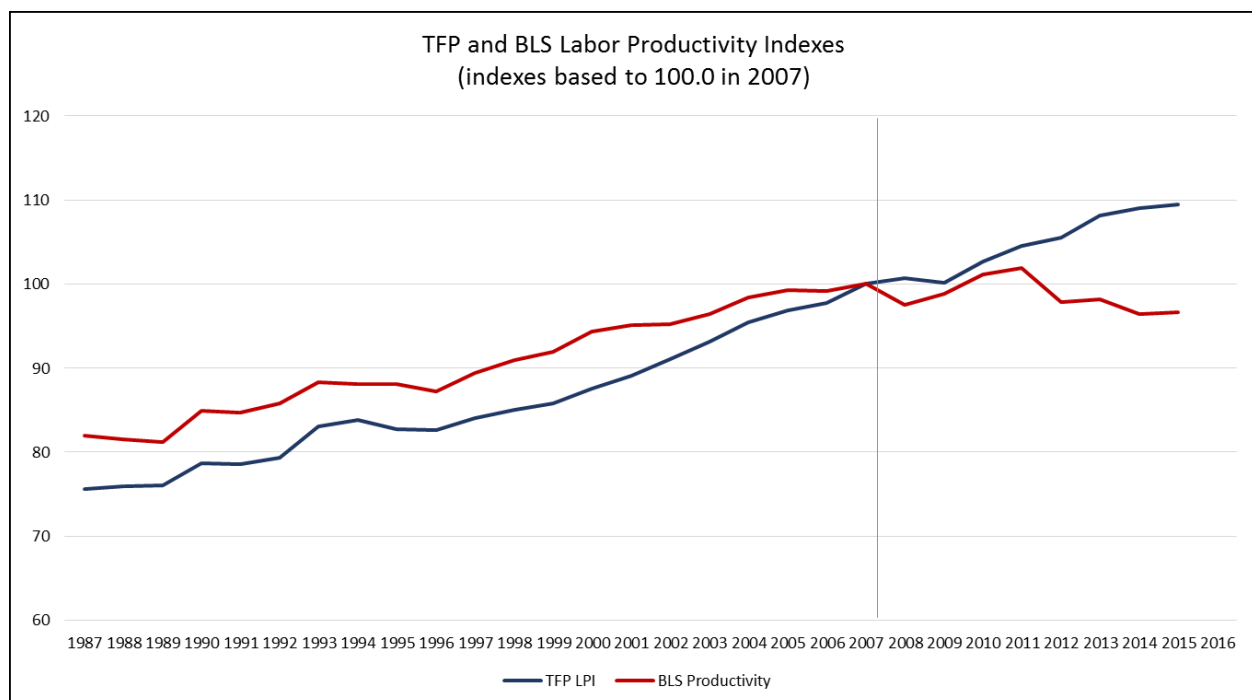
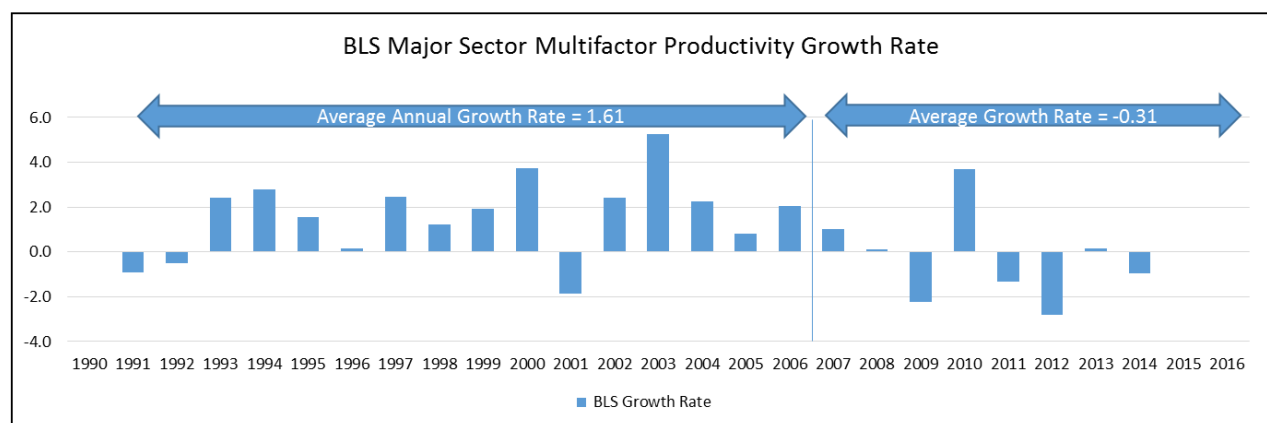
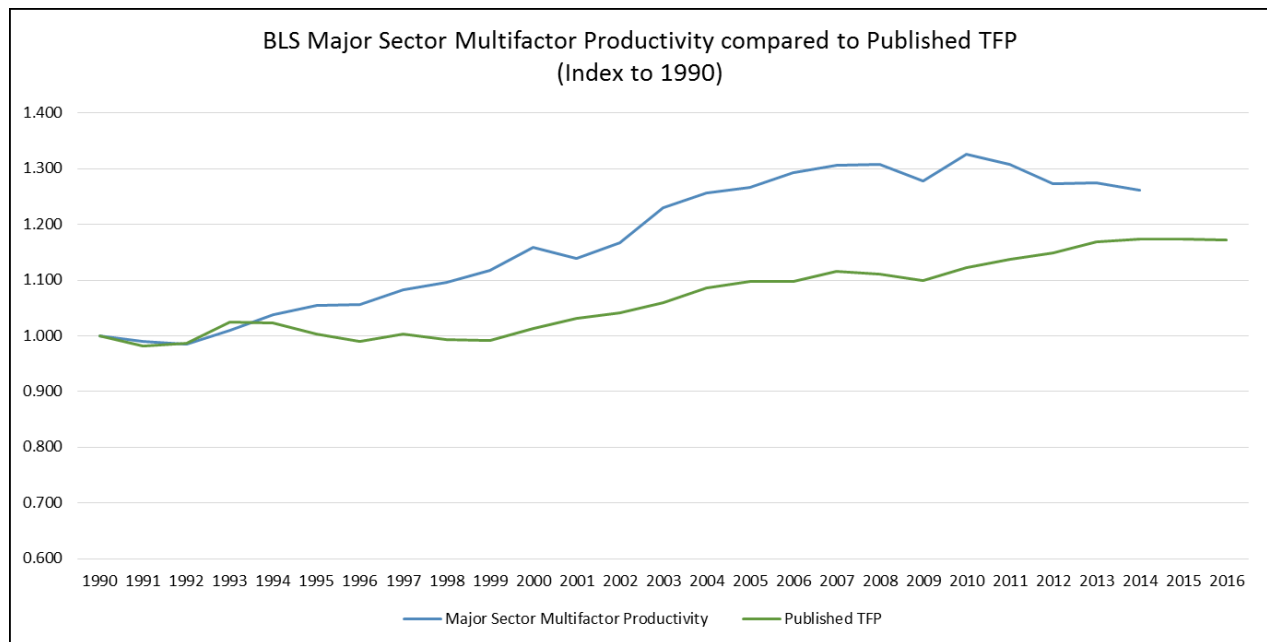


Figure 38: BLS Major Sector Multifactor Productivity compared to TFP



The previous table compares the BLS Major Sector Productivity with TFP. Major Sector Productivity rises more rapidly than TFP from 1994 until 2007. At that time, TFP coincidentally, with the start of PAEA begins to make up ground.

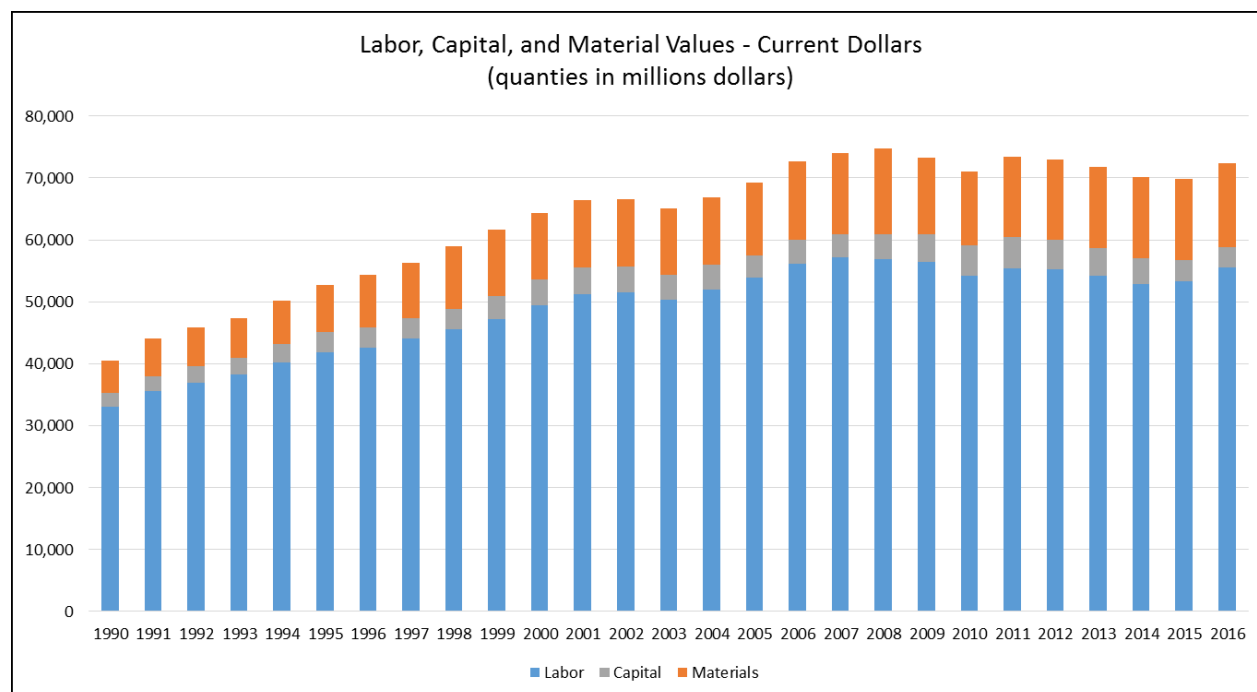
IV. Before & After Analysis of TFP Components

This section examines the components used to calculate TFP over the Before and After Periods. The NWPC TFP Model is used to create some new sub-indexes and specific analysis to examine specific aspects relative to the Underlying factors. It is also used to examine the Underlying, Exogenous, and Pricing Factors as part of the analysis. Some of the fundamental aspects of evaluating productivity in the Before and After PAEA periods are identified in this section. For example, the exogenous events of electronic diversion, eCommerce with package growth, and the economy's impact on mail volumes are can be seen in the component analysis.

As a final step in the calculation of the Input index, the change in Quantity of the Labor, Materials, and Capital components are weighted using their respective share of the percentage of the Values. Values for Labor and Materials are based on the actual current year dollar expenditures. Capital Value results from the TFP Capital methodology. The total value is shown in the following graph for a reference point in the component analysis.

In general, after steady linear growth in the Before period, the Total Value has been relatively stable in the After PAEA period. The relative shares of Labor, Materials, and Capital have changed slowly within a narrow range over the 27-year period.

Figure 39: Labor, Capital, & Material Dollars



1. Labor

This section examines the Labor component of TFP.

A. Published Labor Results

The Current Dollar Labor Compensation by Occupation, Workhours by Occupation and Labor Quantity are shown in the following graphs. The TFP methodology combines these Dollars (Value) and Workhour components into the Labor Quantity. This process is reviewed in detail in Report 1.

The Labor Quantity Index can be segmented into the individual indexes by Occupation group. The TFP methodology combines these to form the Aggregate Labor Index using the share of value (dollars). The individual Occupation group indexes are shown in two graphs to segment the primary operational indexes from the indirect occupation. The Aggregate Labor Index is shown on these graphs.

The Wage Rates are shown on two separate graphs. The wage rates for some Occupation groups did go down in recent years. This can be attributed to the changes in the labor force, primarily the transition starting in 2013 of replacing some higher cost career employees with lower cost non-career employees. This reduction is primarily in the Clerk / Mailhandler and City Carrier Occupation groups. This has the result of lowering the Aggregate Labor Index and increasing the Labor Productivity when compared to workhour base productivity metrics.

Figure 40: Current Dollar Labor Compensation by Occupation

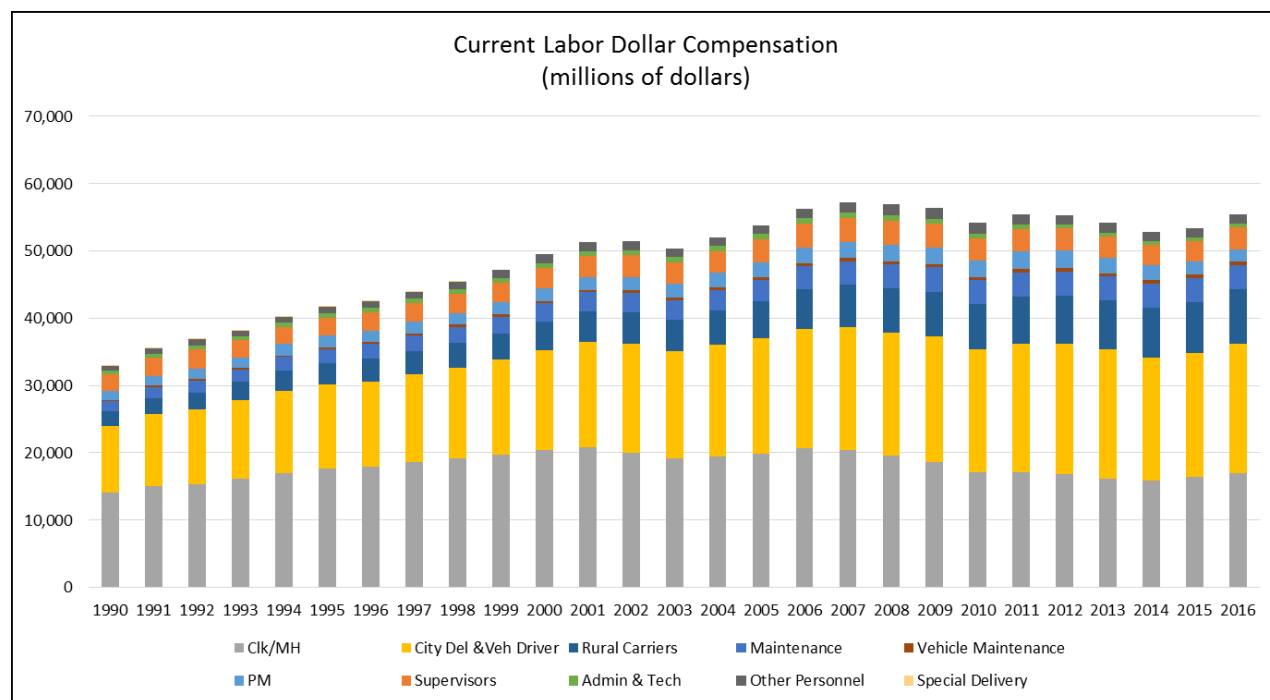


Figure 41: Annual Workhours by Occupation

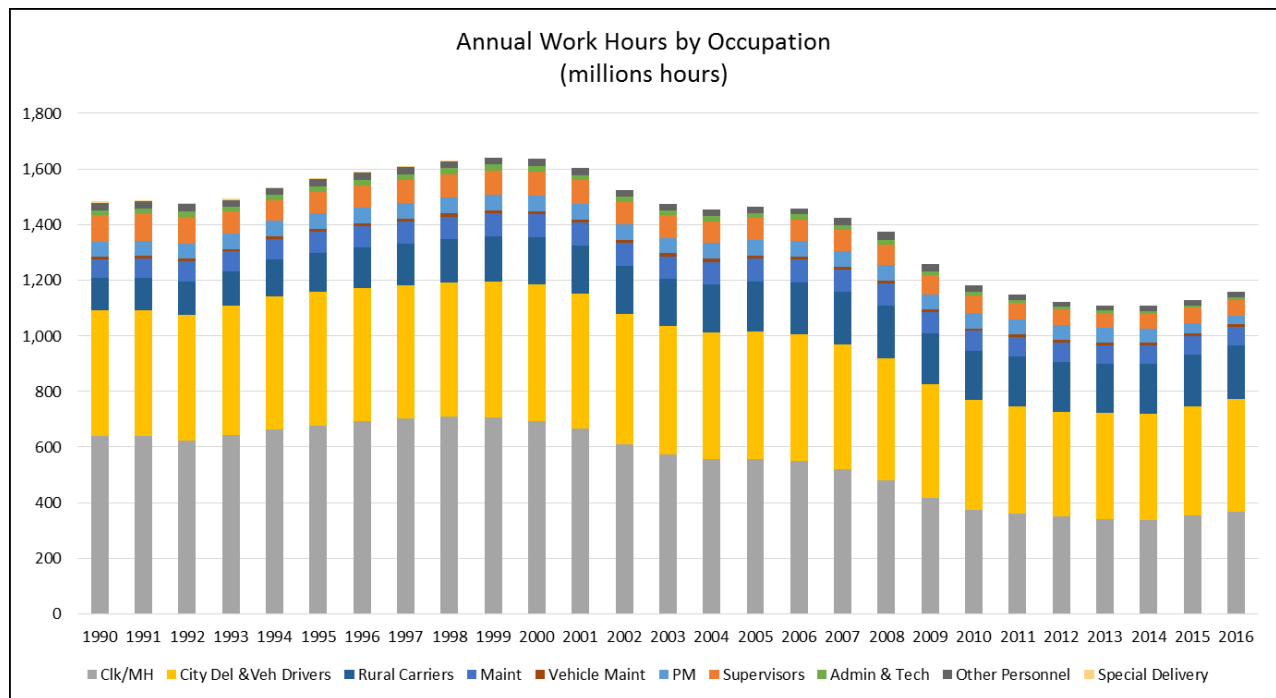


Figure 42: Labor Quantity by Occupation Category

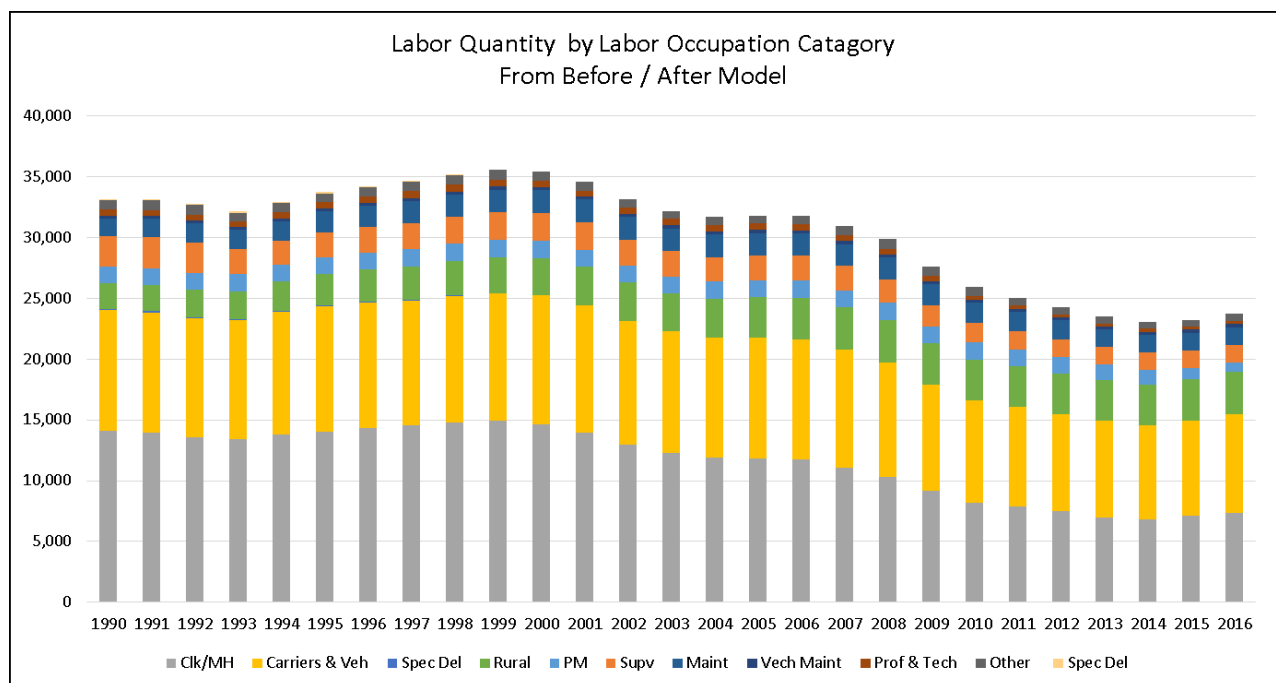


Figure 43: Labor Quantity Indices – Clerk / Mail Handler, City Carriers, Rural, & Total

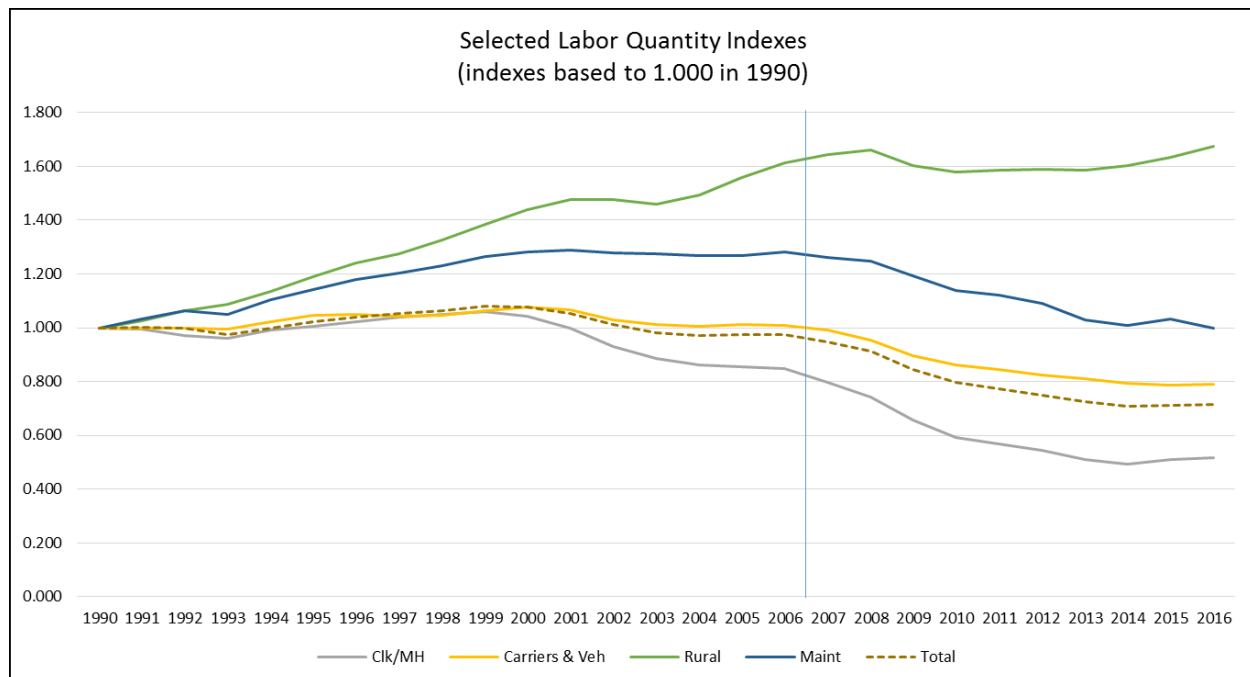
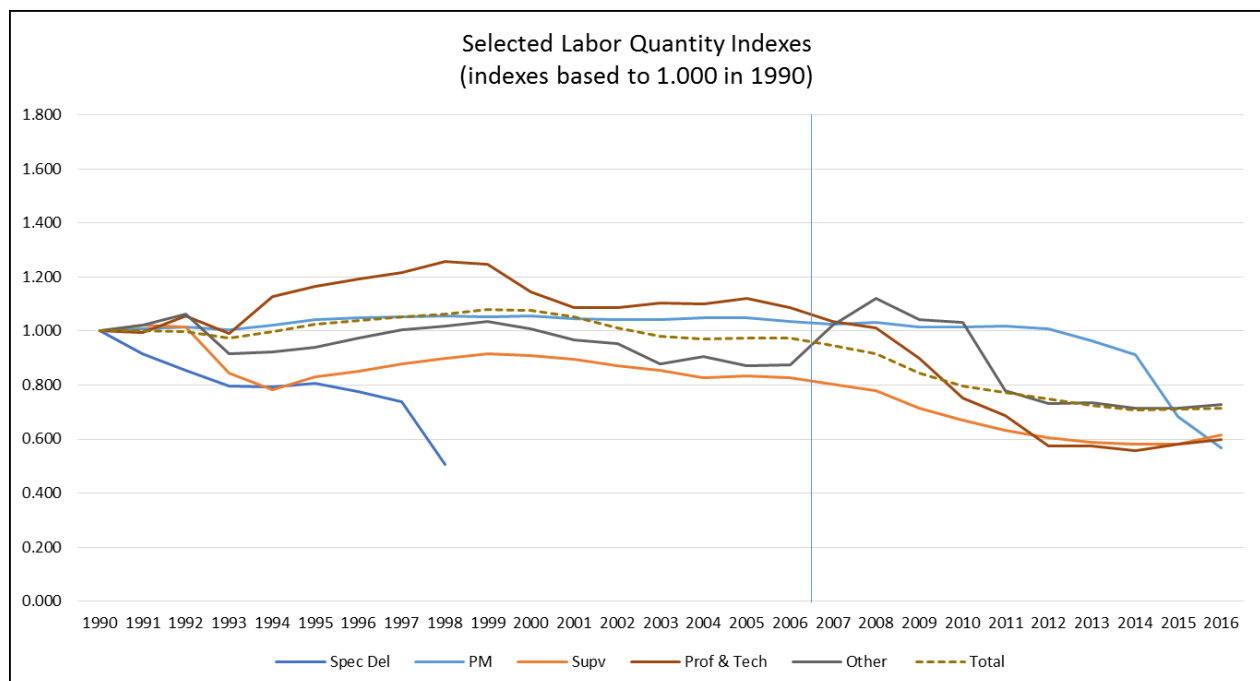
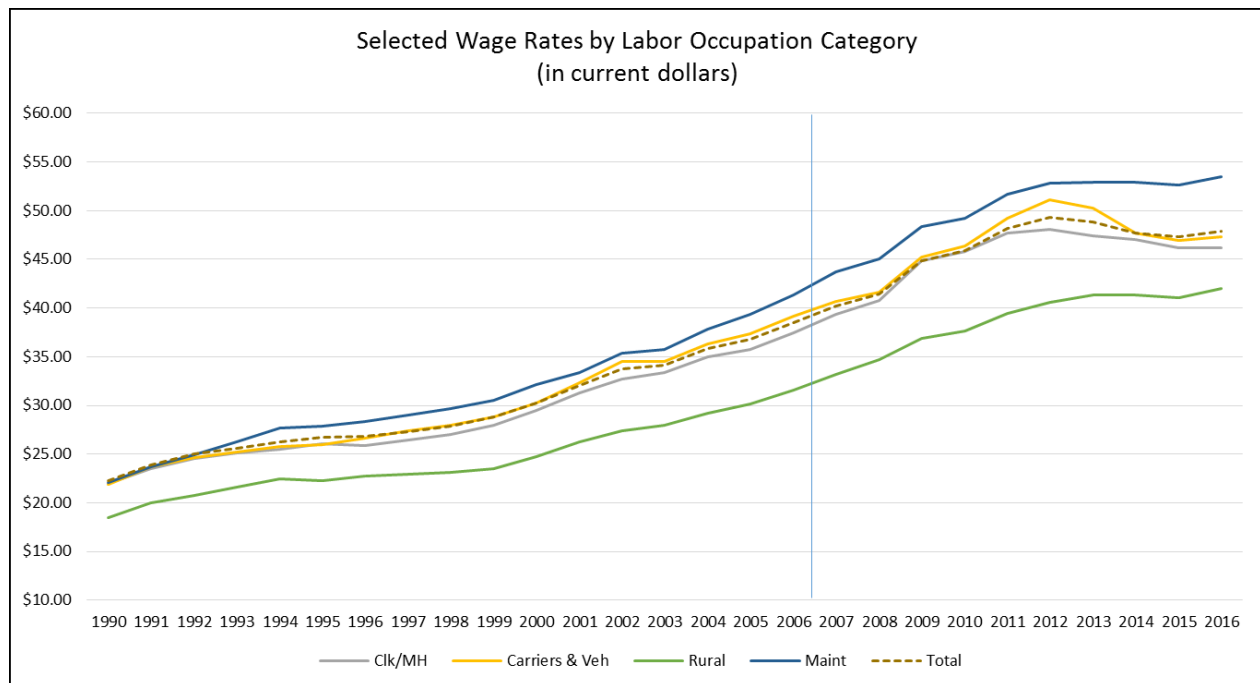


Figure 44: Labor Quantity Indexes – Selected Occupations



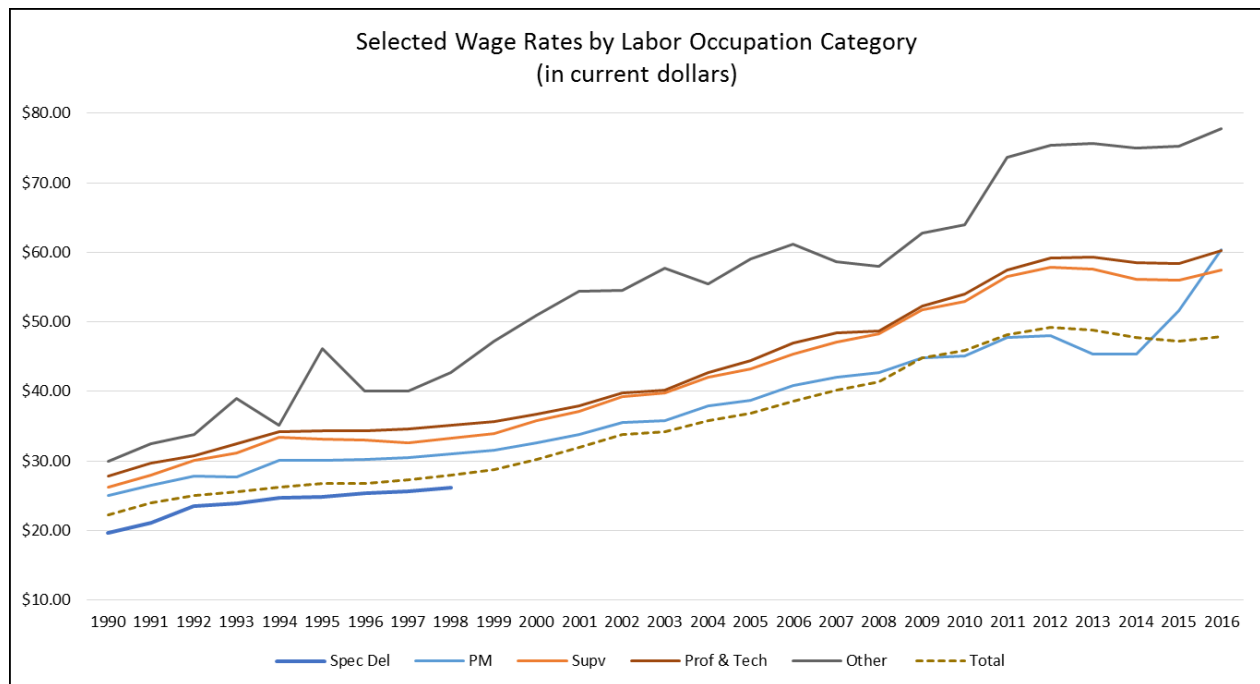
- Labor quantities for most categories have shown a decline since around 1997.
- Special Delivery messengers were eliminated in 1998.
- The Other category showed an increase from 2006 to 2008 followed by a large decline through 2011.
- Postmasters showed a substantial decline starting 2014 as the POST Plan was being implemented.

Figure 45: Wage Rates by Labor Occupation – Clerk/MH, City Carriers, Rural, & Maintenance



- City Carriers / Vehicle Drivers, along with Clerks / Mailhandlers, decline from 2013 to 2015.
- Rural carriers and maintenance wage rates flatten during the same period.

Figure 46: Wage Rates by Occupation – Selected Categories



- All of these categories show at least gradual increases over time.
- The Other category, which includes postal executives, shows a significant increase from 2011 to 2012.
- Postmasters showed a significant increase from 2014 to 2016.

B. Impact of Shift to Non-Career Employees

The Postal Service was able to negotiate increased levels of Non-Career employees in the 2011 labor contracts. The TFP methodology reflects the impact of the combination of changes in hours by employee type and their share of dollar cost. This effectively captures the impact of shifting hours between categories with different wage rates.

The labor negotiation contractual levels allowed for non-career employees have varied over the 27 years of this analysis. For Clerks and to a lesser extent, City Carriers, Transitional Employees were used during the implementation of the letter and flat automation. The use of non-career employees was severely reduced between 2008 and 2011.

The impact of the change in employee categories for Clerks/Mailhandlers, City Carriers, and Rural Carriers is shown Figure 47. It shows the difference between the actual hours and the Quantity calculation base on hours and cost share. The divergence starting in 2012 quantifies the impact of the expanded use of non-career employees through the TFP index methodology. This graph also shows the magnitude of the reductions in actual Clerk / Mailhandler hours through the 27-year period.

As the automation program reached maturity and the volume reduction leveled out, the opportunity to reduce their hours further diminished. After the 2008 Recession, in Mail Processing, the opportunity was generally limited to additional parcel automation, FSS, network facility consolidation, and operational process improvements.

Figure 47 shows the actual Clerk/Mailhandler hours since 2011. In a broad sense, as volume generally leveled out in First Class Mail and Standard Mail, the change in hours can be generally attributed to the efforts described above. This impact has been minimal as compared to the historical reductions in Clerks / Mailhandlers prior to the 2008 Recession. In fact, hours have returned to the 2010 levels.

The contribution to TFP from Clerks/Mailhandlers is primarily due to the substitution of the non-career for career employees. Non-Career employees represented 18.5 percent of total hours in 2016, up from 4.0 percent in 2010. The previous high-use period for non-career was 1993 to 1998 when it consistently ran around 13 percent.

In City Carriers, non-career hours have been 20 percent of total hours for the past two years (2015-2016). The additional training and attrition related costs for non-career employees would be reflected in the Quantity calculation as it is included in the cost data.

The impact of the increased use of non-career employees can be seen in the difference between the actual hours and the quantity. This is shown in Figure 48. It shows the index for these categories, with 1990 set to one. The graph shows both Clerks / Mailhandler and City Carrier hours have been relatively flat since 2010, decreasing slightly then increasing back to the 2010 level. Productivity increases have been realized through the increase in lower wage rate hours through the increase in non-career employees.

Figure 47: Impact of Non-Career on Hours versus Quantity – Clerks/MH, City, and Rural

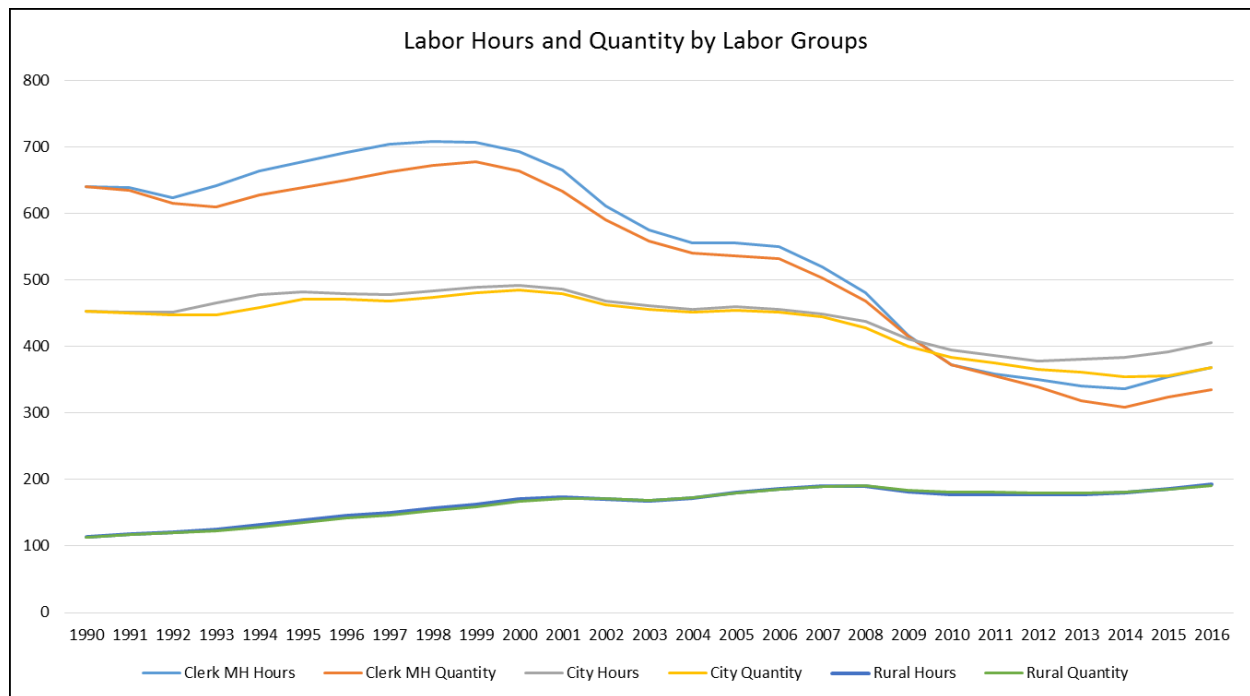


Figure 48: Index Results - Non-Career on Hours versus Quantity – Clerks/MH, City, and Rural

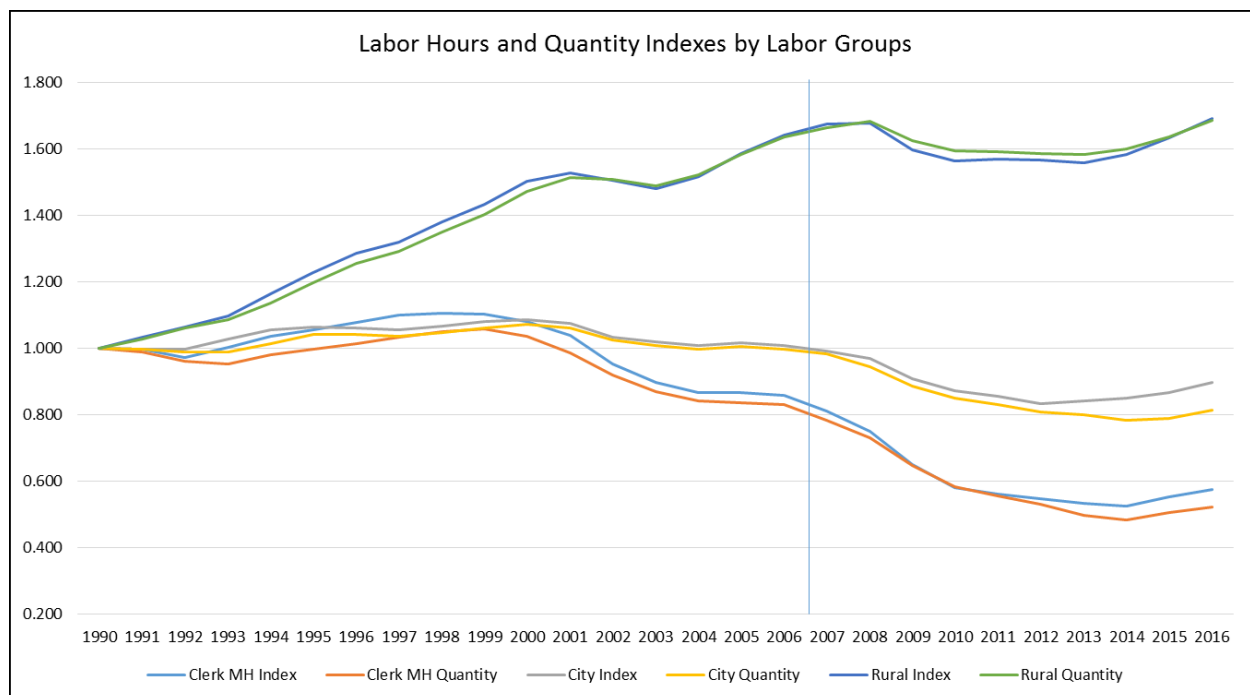


Figure 49: Growth Rates – Hours versus Quantity – Clerks/MH, City Carriers, & Rural Carriers



- These growth charts show the difference between actual workhours and the Labor Quantity calculation.
- The Labor Quantity calculation reflects the impact of changes in employee mix and the associated wage rates.
- The impact of the shift starting in 2011 can be seen in Clerks / Mail Handlers and City Carriers.
- In the 1990's and early 2000's, Transitional Employees were used in Clerks / Mail Handlers.
- Early retirement periods where large numbers of top wage rate employees leave can also be observed in 1993 and 2009.

2. Capital

The Capital value and quantity results are calculated in a separate process by Christensen Associates. This process is documented in Appendix 3 – Reference Documents.

The results have been reset to the base year of 1990 for this analysis. In general, Capital does not play a significant role in the TFP results. It has accounted for between five to seven percent of the Total Value of Resources over the 27-year period that means that relatively significant changes in Capital are unlikely to move TFP much.

The components of Capital are presented in the following figures. In general, the Capital Quantity Index increases at a linear rate until 2009, then decreased at a linear rate. Actual Capital investment levels have varied in amount over the 27-year period. In 2016, a substantial investment in Vehicles was made. The increasing level of Postal Support Equipment is likely tied to the growth in data processing and communications equipment.

Figure 50: Capital Values by Category

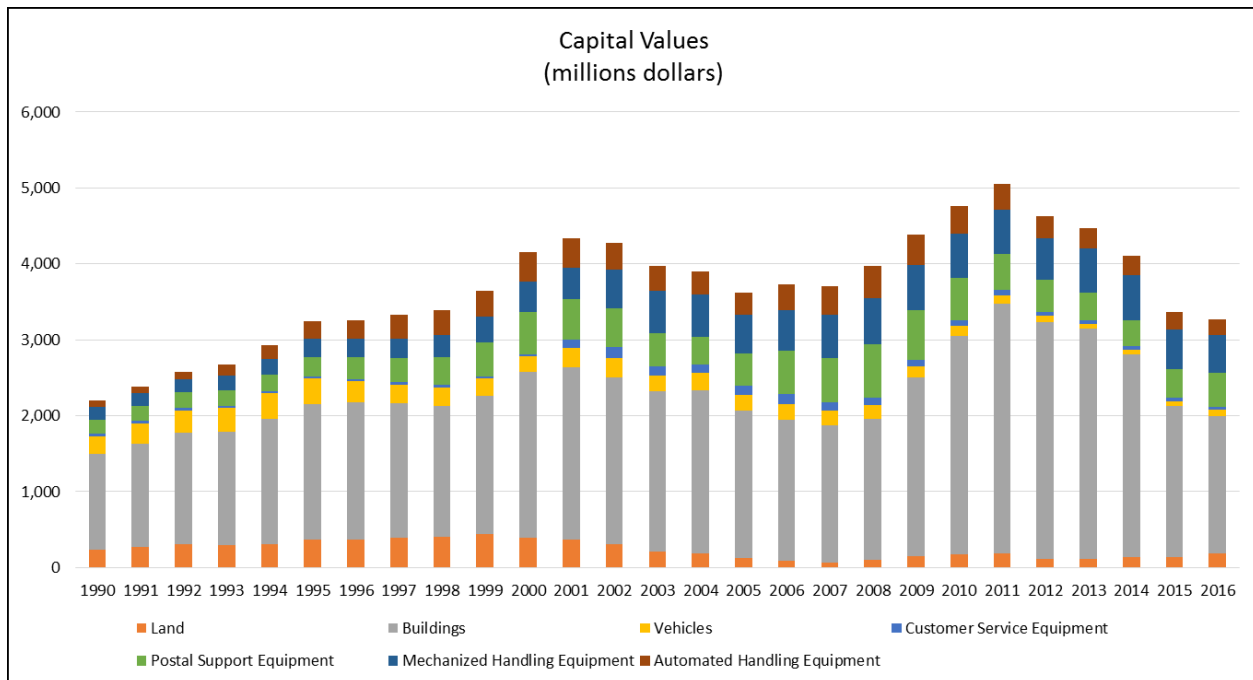


Figure 51: Capital Quantity

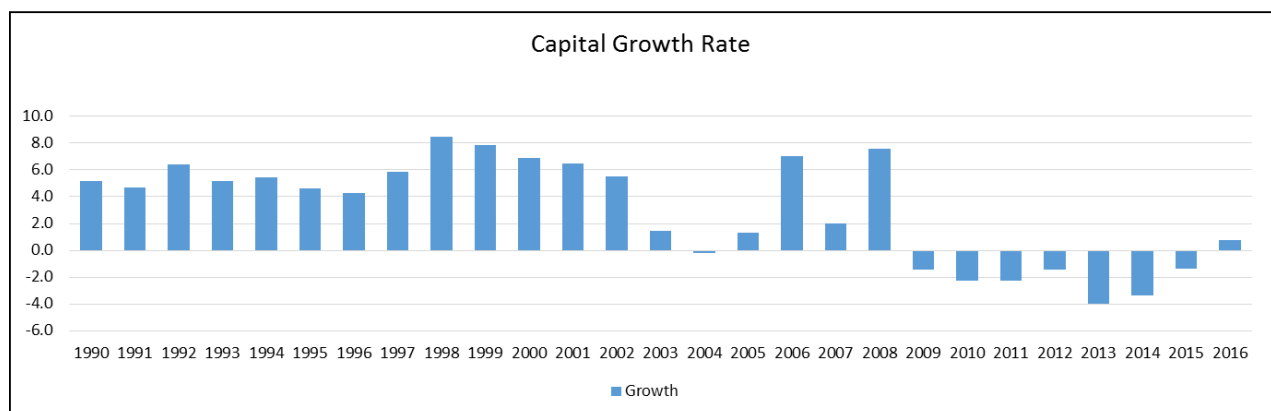
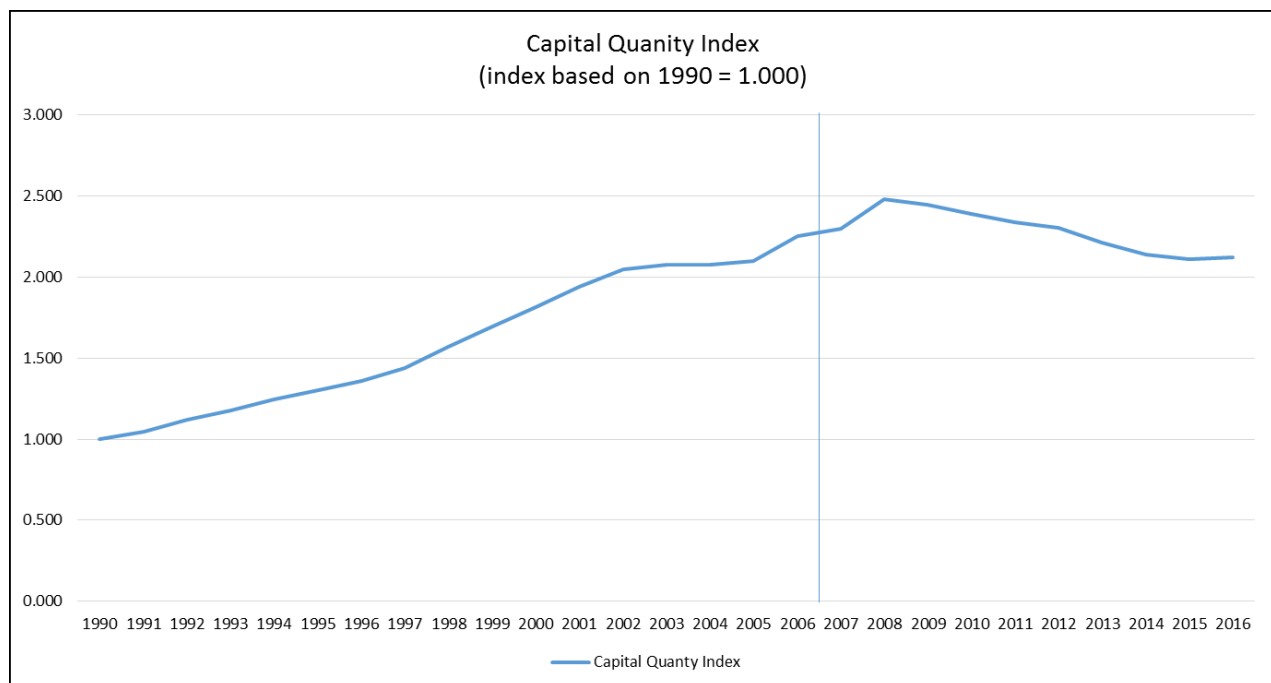


Figure 52: Capital Investments in Current Dollars

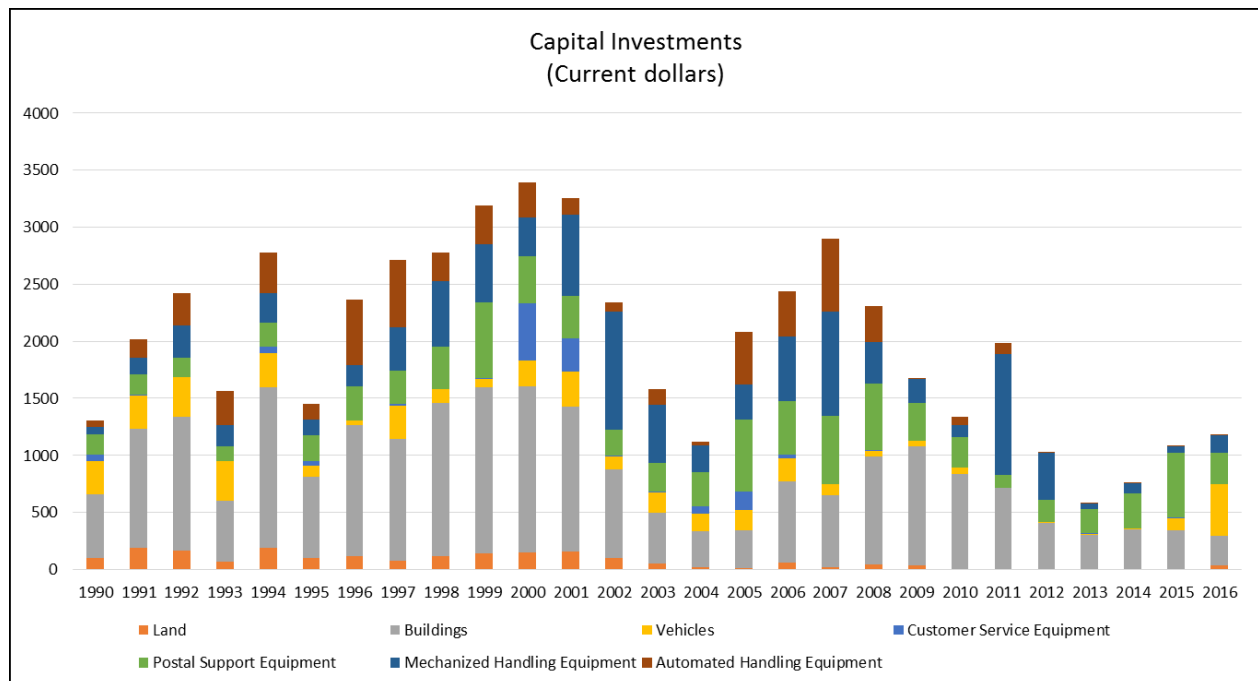
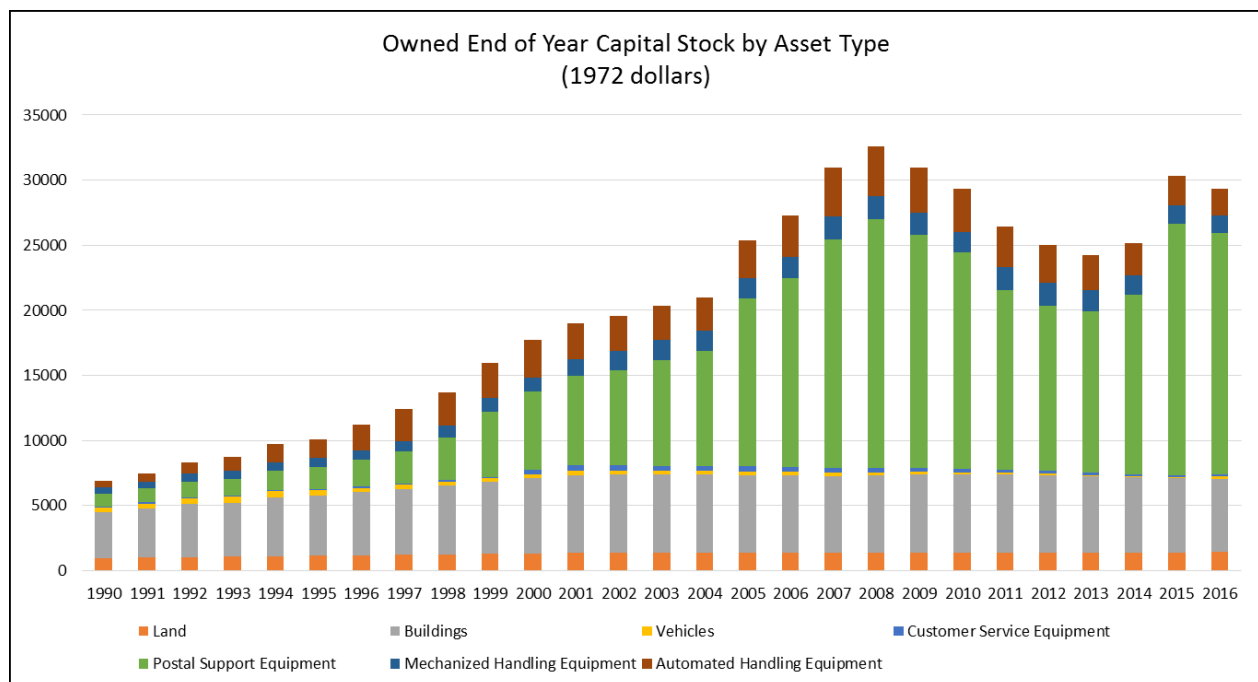


Figure 53: Owned End of Year Capital Stock by Asset Type



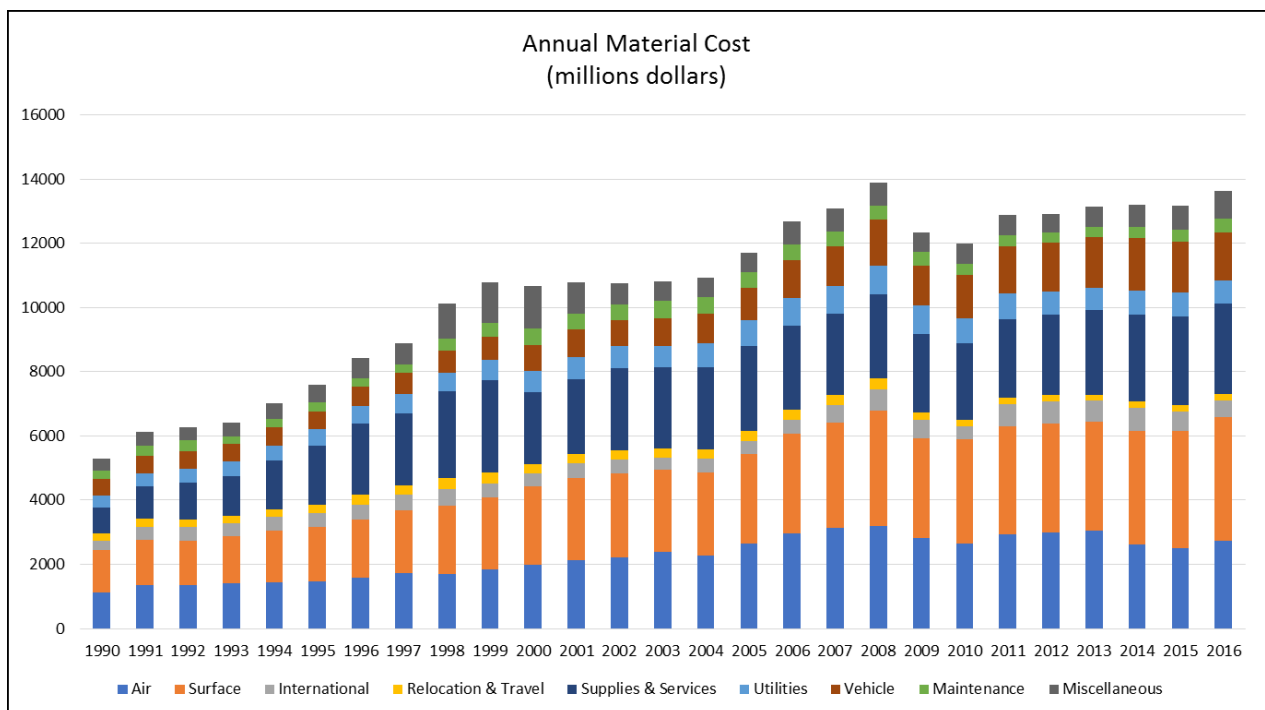
3. Materials

Materials accounts for between thirteen and nineteen percent of the Total Value. It has been generally increasing over the 27-year period. There are 30 categories in the materials index methodology. These are documented in Appendix 3 – Reference Documents.

A. Published Materials

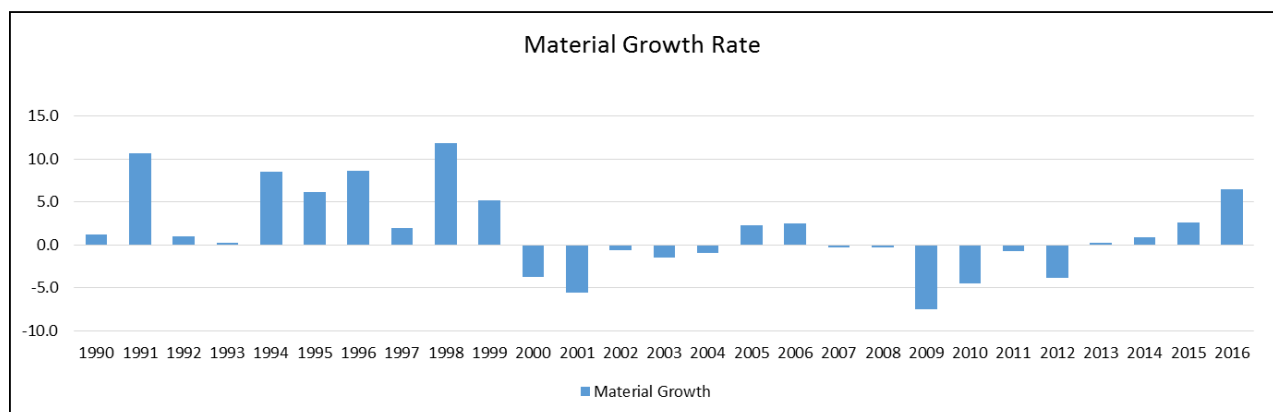
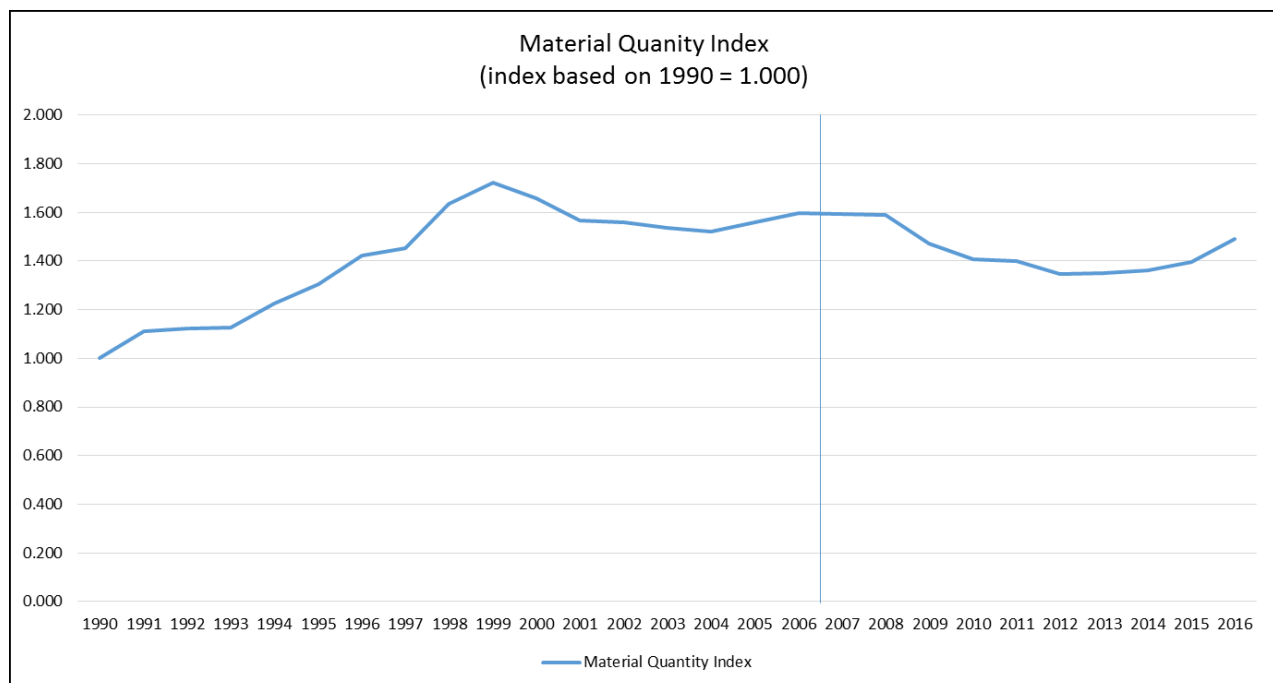
The figure below shows the Material expenditures in current dollars. The categories were created for the purposes of the report analysis.

Figure 54: Annual Materials Cost



The Materials Quantity Index and growth is shown in Figure 55. The spike in 1998 and 1999 is believed to be caused by Y2K expenditures in Miscellaneous Services and Professional Services. In general, Materials had an increasing impact until 1997. After the Y2K spike of 1998-2000, the component has a relatively constant impact on TFP. There was a drop in the index after the Recession and is now back on the increase.

Figure 55: Material Quantity & Growth Rate

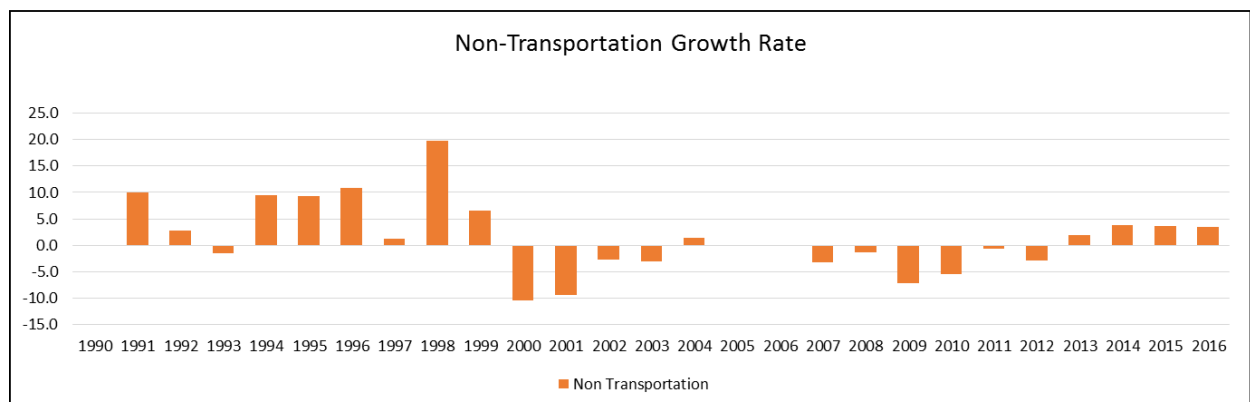
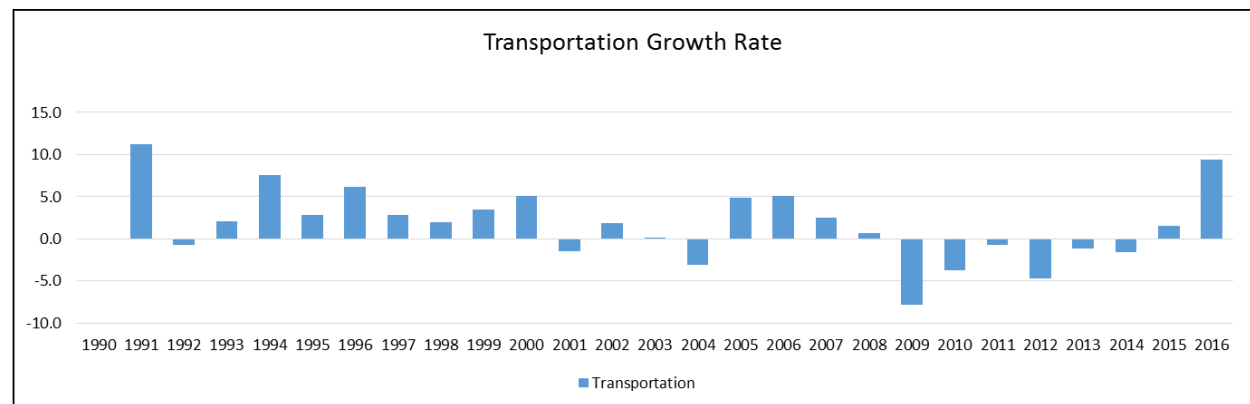
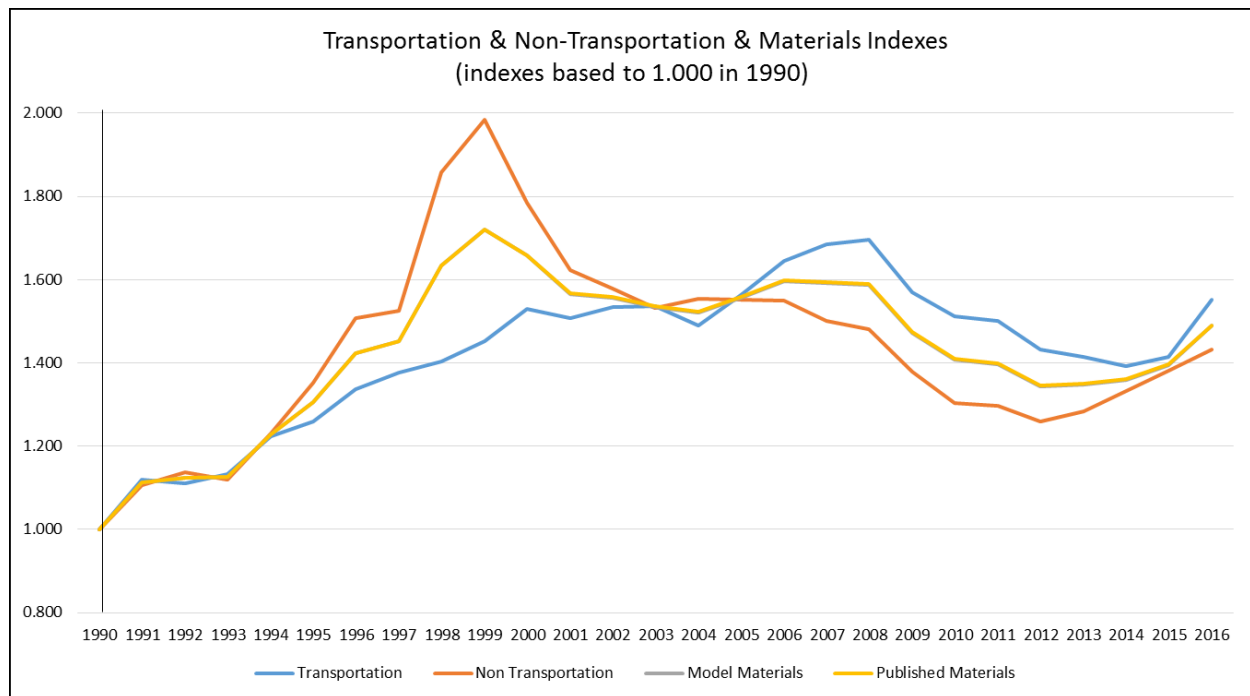


B. Transportation versus Non-Transportation Indexes

The index process was used to separate the Materials categories into two groups – Transportation and Non-Transportation. The International categories were included in Transportation. The intent of this segregation was to evaluate the impact of Transportation, separately, as it is directly relates to operations. These indexes are shown in Figure 56.

The size of the Y2K spike in 1998-99 becomes more evident in this analysis. It does show that Transportation has been growing since 2003 while Non-Transportation has been declining. The Transportation Index does show a sharp increase in the past two years. This is consistent with published summaries of performance, where transportation costs increased to address network and service performance issues.

Figure 56: Transportation versus Non-Transportation Material Indexes & Growth Rates



4. Output - Weighted Mail Volume

The analysis of the components of TFP for the Before and After PAEA periods required the development of a specialized TFP model. NWPC followed the methodology developed for Report 1 to reset the TFP to the Base Year of 1990. For the primary results, this was a simple calculation using the published index data.

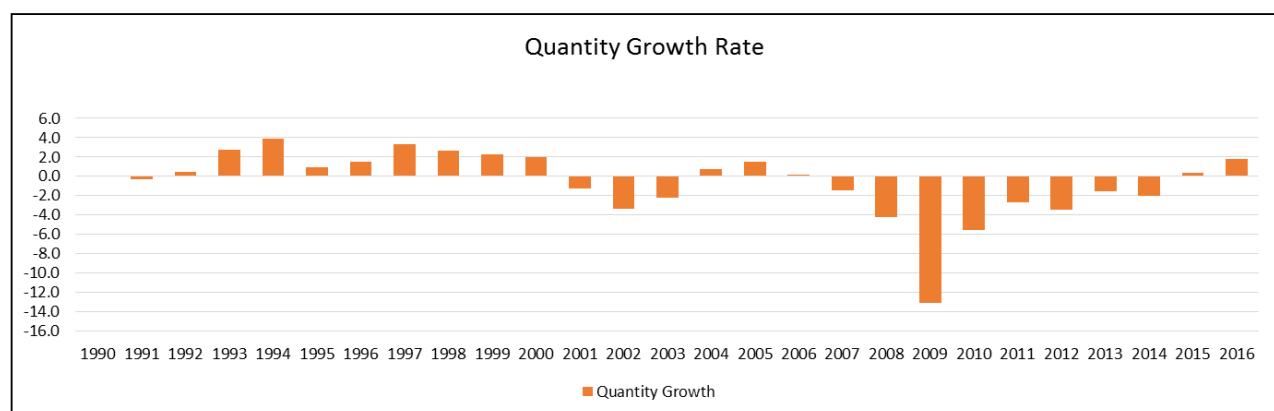
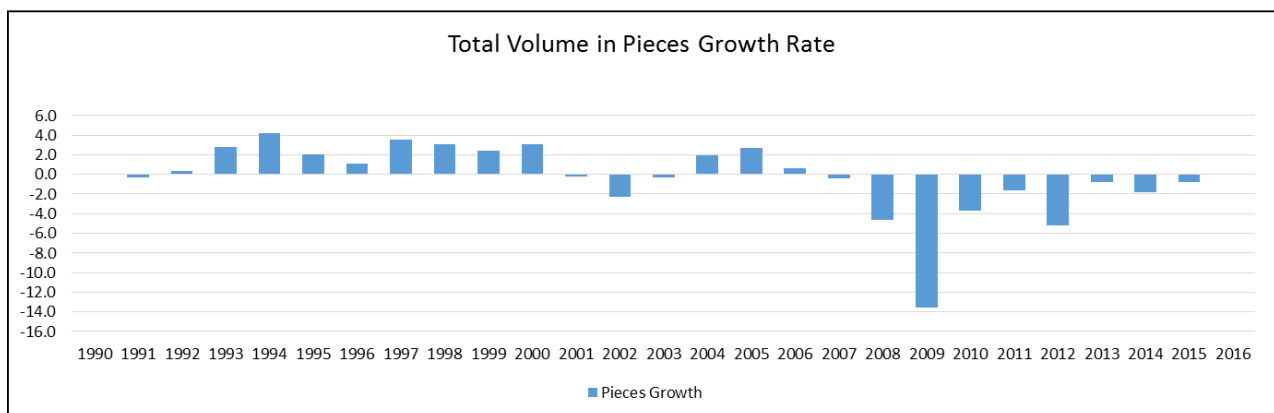
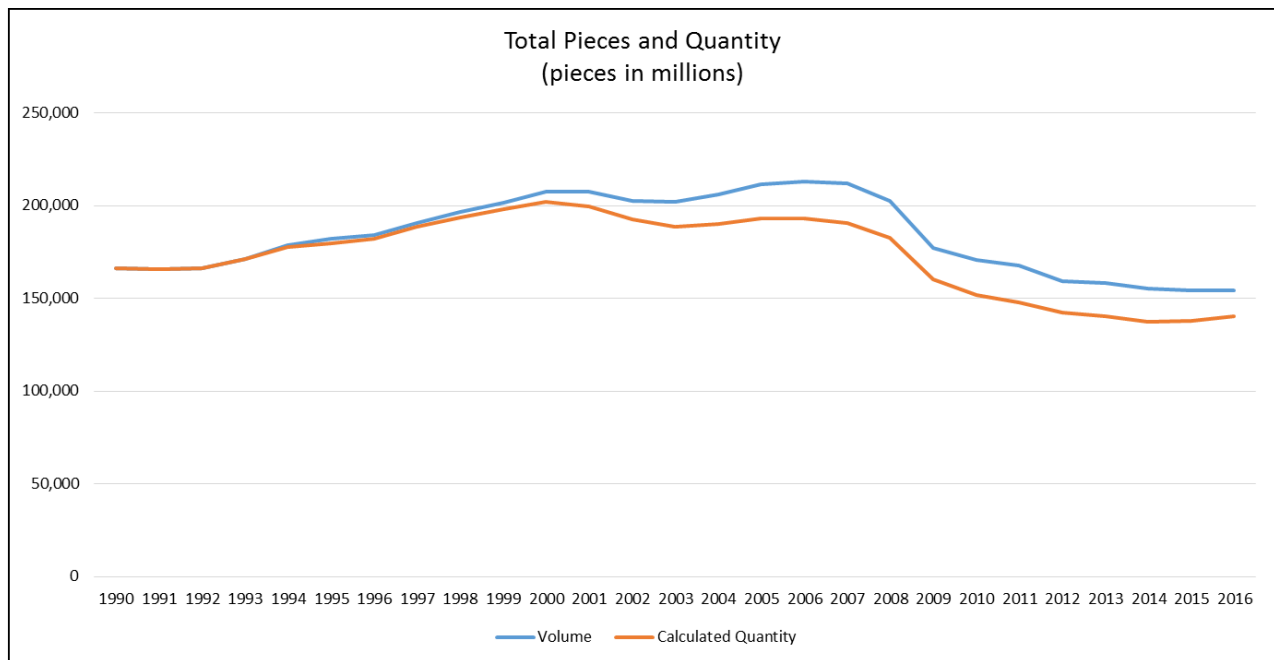
This approach could not be used for the weighted mail volume. The resetting of the Quantity in 2008 to actual 2008 volume with a one-time adjustment factor could not be replicated based on the information available. Instead, the 1990 actual mail volume was used as the starting point. The classification changes in 2008 were then handled using the normal methodology adjustment process for addressing category changes that occur between years. This approach also allowed for several other methodology adjustment issues to be handled consistently across the entire 27-year period and is consistent with the overall TFP adjustment processes.

The comparison of actual mail pieces to the Weighted Mail Volume result, or Quantity, is shown as Figure 57. This graph represents how the index process and TFP methodology combines the different Mail Products together to create the basis for the Weighted Mail Volume component of Total Output.

Reviewing the graph, increased workshare reduces quantity relative to mail volume from 1994 to 2013. After 2013, the increase work content associated with growth of parcels, particularly Parcel Select, begins to gradually reduce the gap between mail volume and TFP Quantity. This result provides even more insight when the changes in volume and changes in share of attributable cost are reviewed together.

The model results are validated against the published results in the model to ensure accurate results. The results of the validation of the published TFP Tables, including the explanation provided by Christensen Associates, are provided as part of Appendix 3 – Reference Documents.

Figure 57: Before / After Model – Mail Volume Methodology



A. Published Output Components

The Mail Volume in pieces, Attributable Cost in current dollars, and the Percent of Attributable Cost are shown in the following figures. These are combined to calculate the weighed mail volume. This methodology is explained in detail in Report 1.

Figure 61 shows the Quantity by Mail Product in bar chart form. It should be noted that the Total Weighted Mail Volume Quantity is not the sum of these bars. Rather, it is the result of the index aggregation calculation. This process uses the share of the Attributable Cost to weight the change in piece volume over the previous year.

This methodology results in the large increase in Parcel Select in both pieces and attributable cost over the past several years to be reflected in Weighted Mail Volume result. In fact, the growth in the more heavily weighted Parcel Select means the Weighted Mail Volume Index has increased in past two years while piece volume has actually decreased. This is shown in the growth rates of Figure 57 that compares the piece volume with weighted mail volume quantity.

This is a good example of how the TFP methodology does account for the work content of volume changes based on the attributable cost results. Weighted mail volume growth in the past two years can be shown to be directly attributable to the eCommerce (i.e., Parcel Select growth) that more than offset the loss due to electronic diversion (i.e., First Class Mail volume decline).

Figure 58: Mail Volume - Pieces

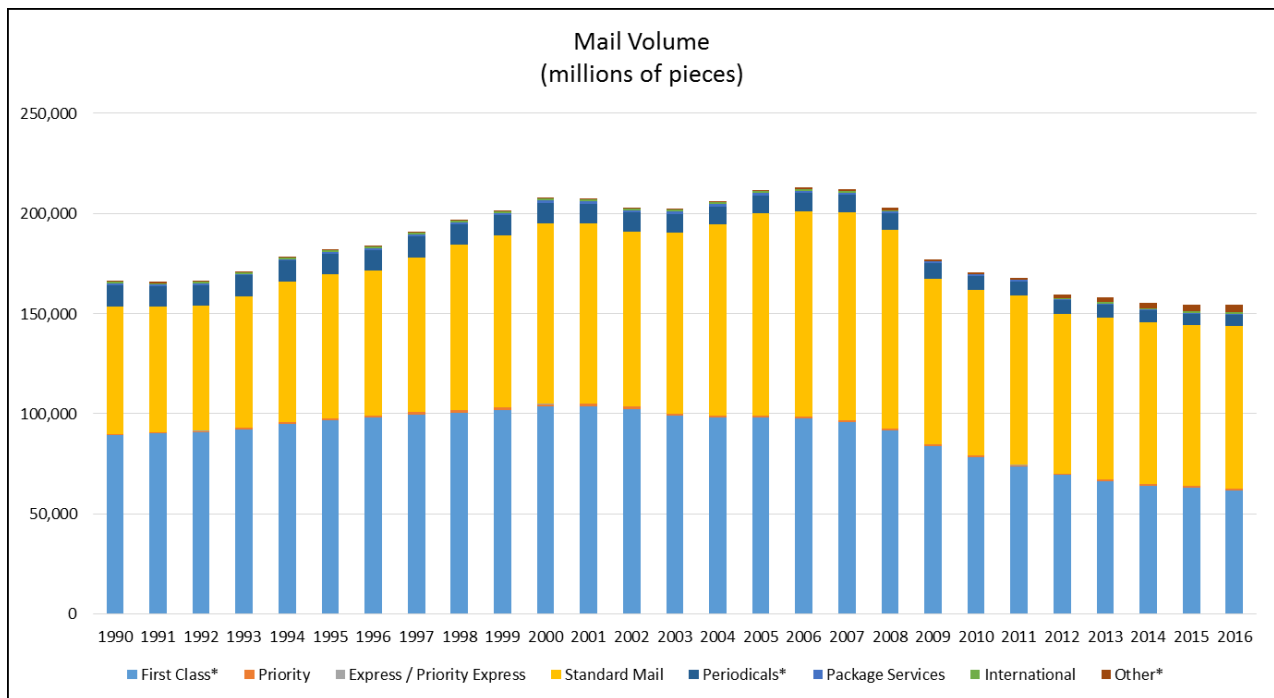


Figure 59: Attributable Cost by Mail Product Category

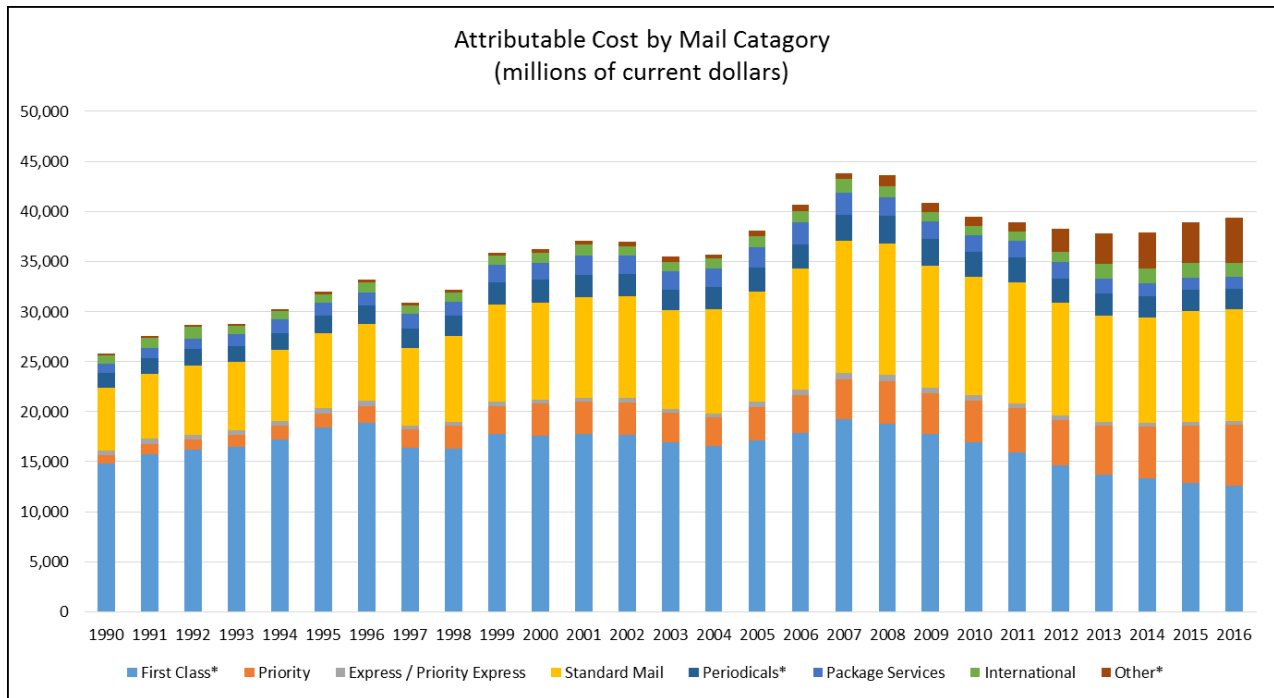
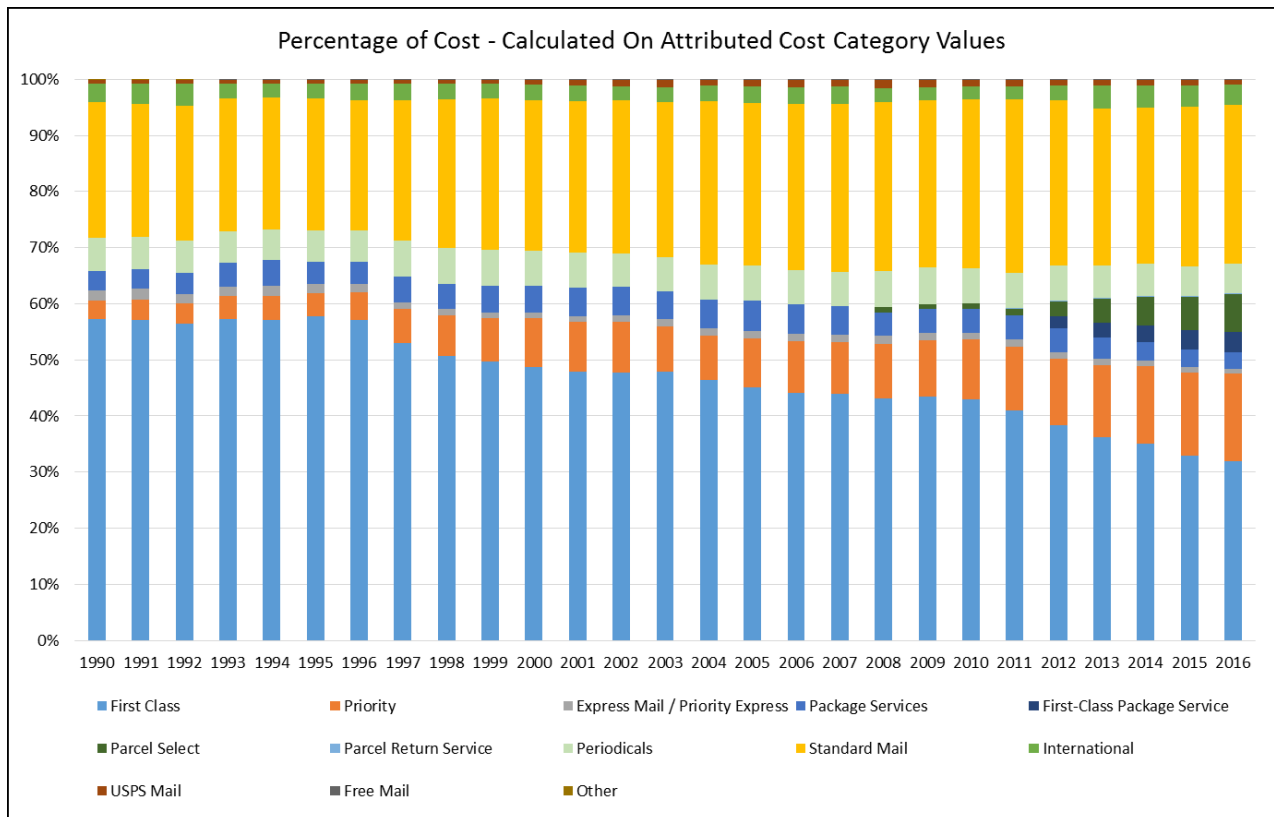
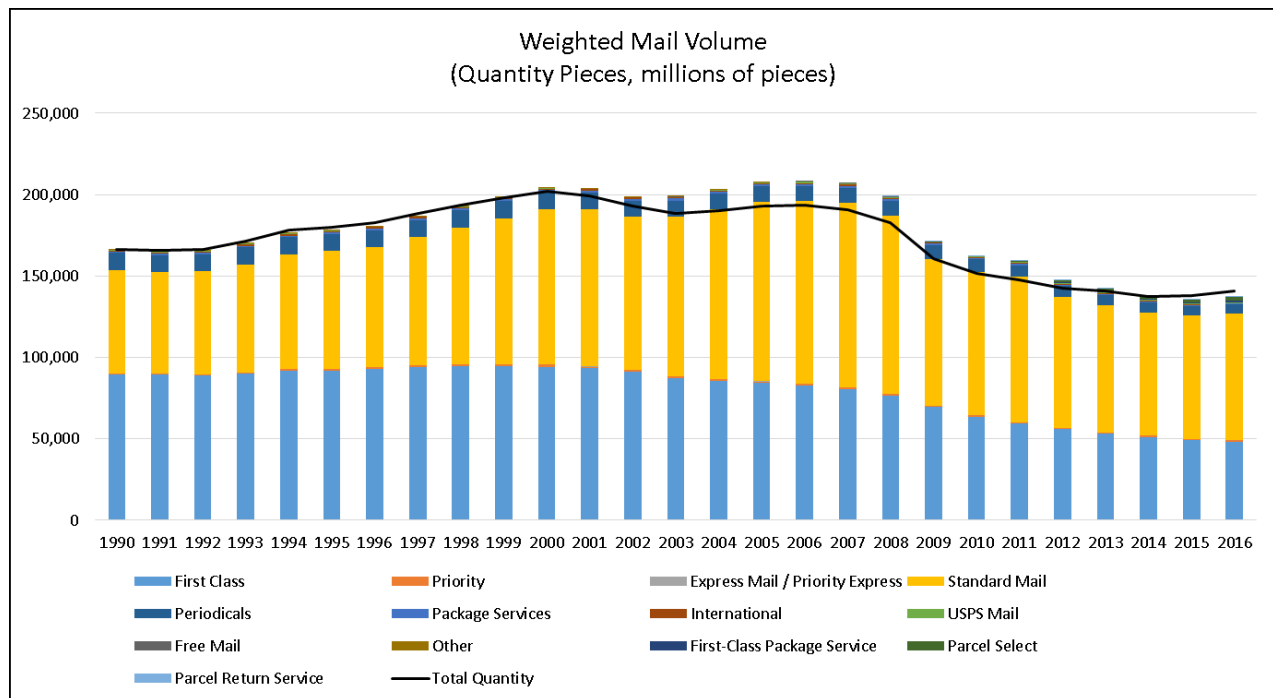


Figure 60: Percentage of Attributable Cost



- The percentage of Attributable Cost is used in the weighting of the piece volumes.

Figure 61: Weighted Mail Volume / Quantity



Cost per piece results are shown for reference in the following figures.

Figure 62: Cost per Piece – First Class, Standard Mail, and Periodicals

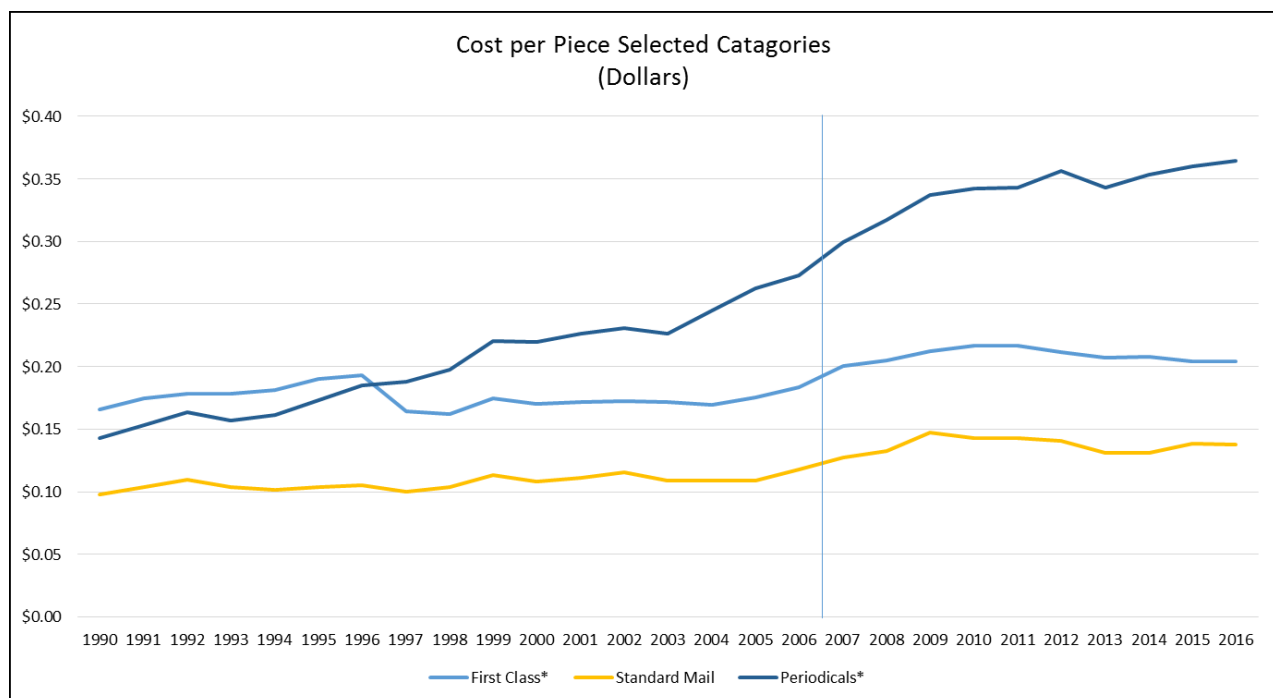
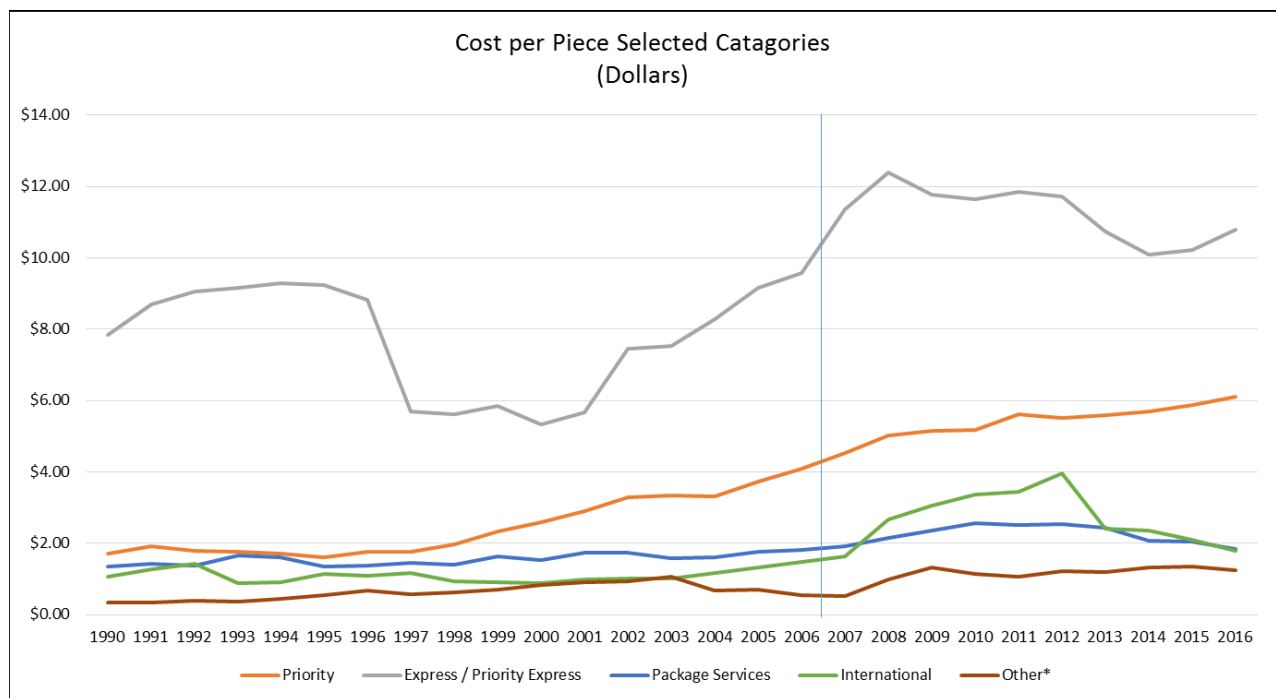


Figure 63: Cost per Piece – Selected Categories



B. First Class – Presort versus Non-Presort Indexes

First-Class Mail has been affected by a number of factors. For instance, the Exogenous Factor, electronic diversion, has reduced the volume of all First Class Mail, particularly for Non-Presort First-Class Mail. In addition to electronic diversion, the more positive classification and pricing factors are used to provide workshare discounts for First Class Mail.

The TFP data can be segmented into both these categories of First-Class Mail - Presort and Non-Presort. This segmentation is shown in Figure 64 and Figure 65.

As mentioned previously, the electronic diversion appears to impact the Non-Presort segment of First Class more than the Presort category. The results show that First Class Non-Presort began to decline around 2000 at a steady rate until the 2008 Recession. It has started to level out in the past few years.

Presort First Class continued to grow until the 2008 Recession. It represented the growth of First Class Mail in the 1990's. When it started to drop, the total First Class Mail volume loss saw a larger drop due to the larger share of First-Class Mail that Presort represents.

Overall, total First Class Mail growth was flat through the early 2000's. The impact on productivity cannot be directly related through the data. However, the Non-Presort First Class more significantly impacts Mail Processing operations, as the Non-presort mail requires more sorting. It requires the outgoing processing, including the cancellation operation at the origin mail processing facility.

Electronic diversion, as measured in First Class Mail Presort, is a primary factor causing the index to move from 1.00 in 1990, to 0.917 in 2000, to 0.357 in 2016. This Exogenous factor of electronic diversion has had a substantial impact on Clerk / Mailhandler workhours over the same period. This impact contributed to the Underlying factors of the Area Mail Processing (AMP) and the network consolidation programs.

The contraction of the Outgoing operations through the AMP process started in the mid 2000's. It began with the smaller facilities where nearby larger facilities could absorb the volume without impacting service standards. The significant volume drop in outgoing First Class Mail (i.e., Non-Presort) led to an expansion of the AMP program starting around 2008. This then became the larger scale Network Rationalization project covered in N2012-1 as total volume dropped with the Great Recession and accelerated electronic diversion. It should be noted that the volume drop of First Class Mail did start to level out in the past several years.

The impact of the growth of Presort in the 1990's also cannot be directly tied to workhour use or productivity performance in this period. Presort growth did counteract the volume loss in Non-Presort in the years before the Great Recession.

The relationship between the Weighted Mail Volume Indexes is shown with the key Labor Classification indexes in Figure 75.

Figure 64: First Class Mail – Presort versus Non-Presort - Volumes

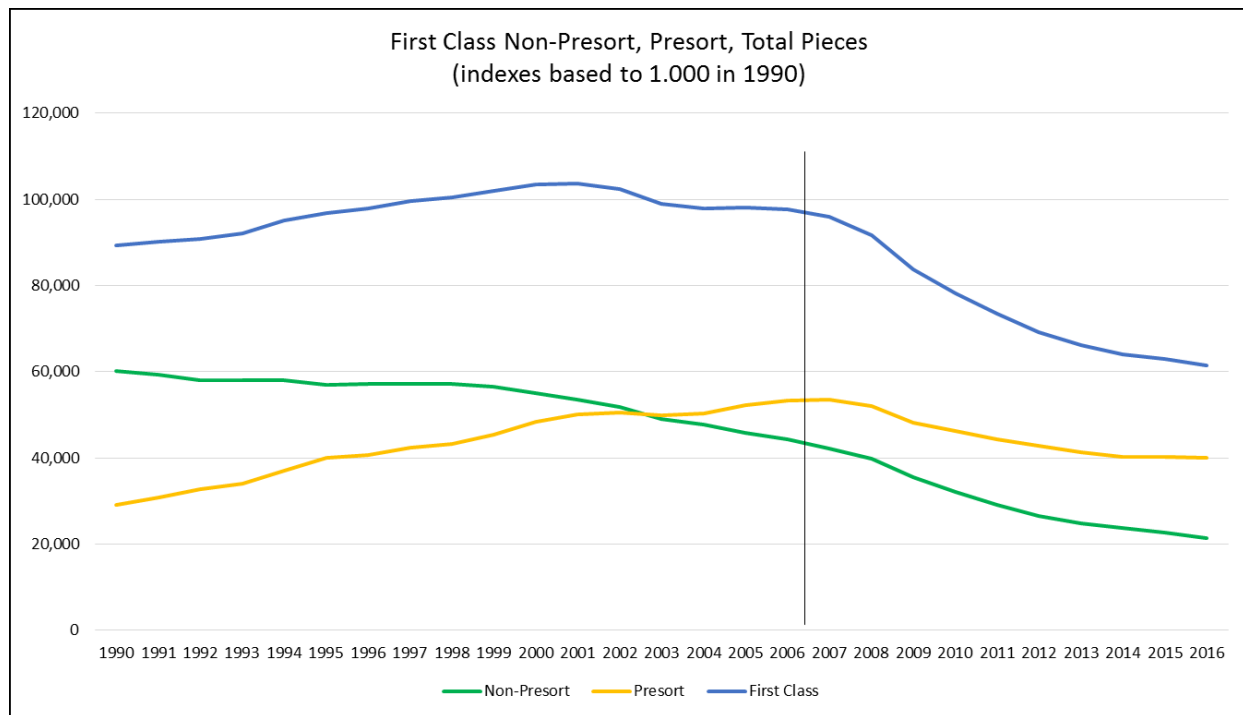


Figure 65: First Class Mail – Presort versus Non-Presort – Indexes to 1990 Base Year

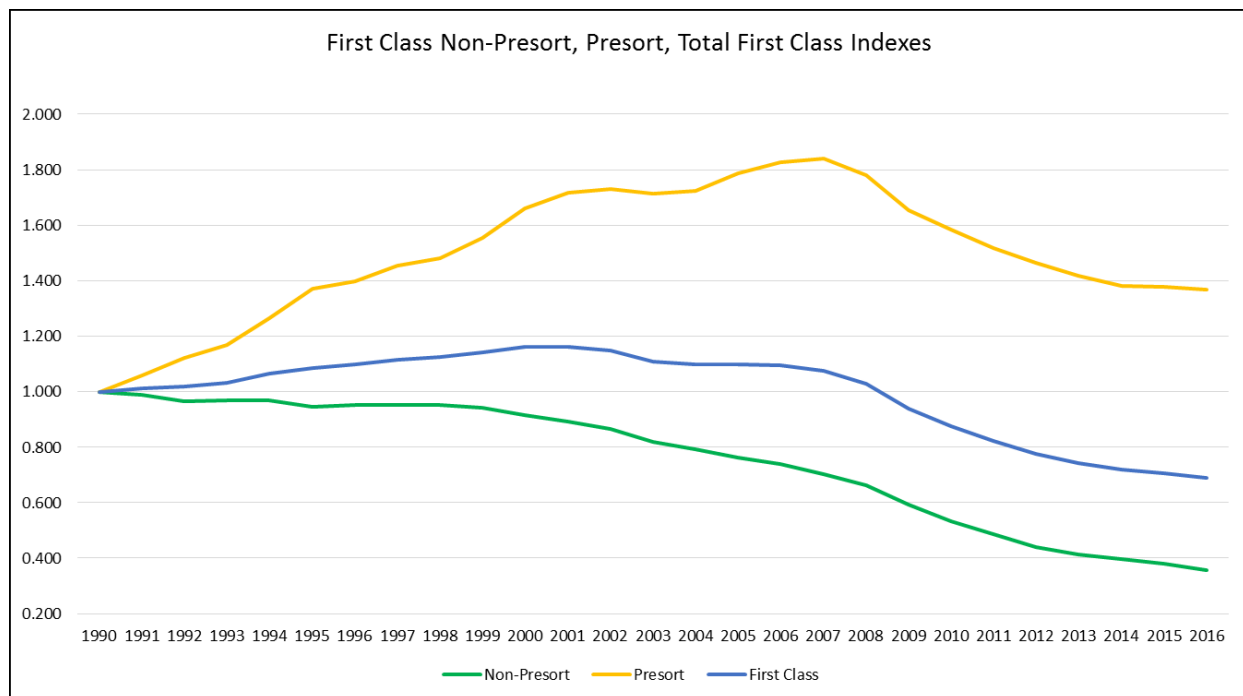
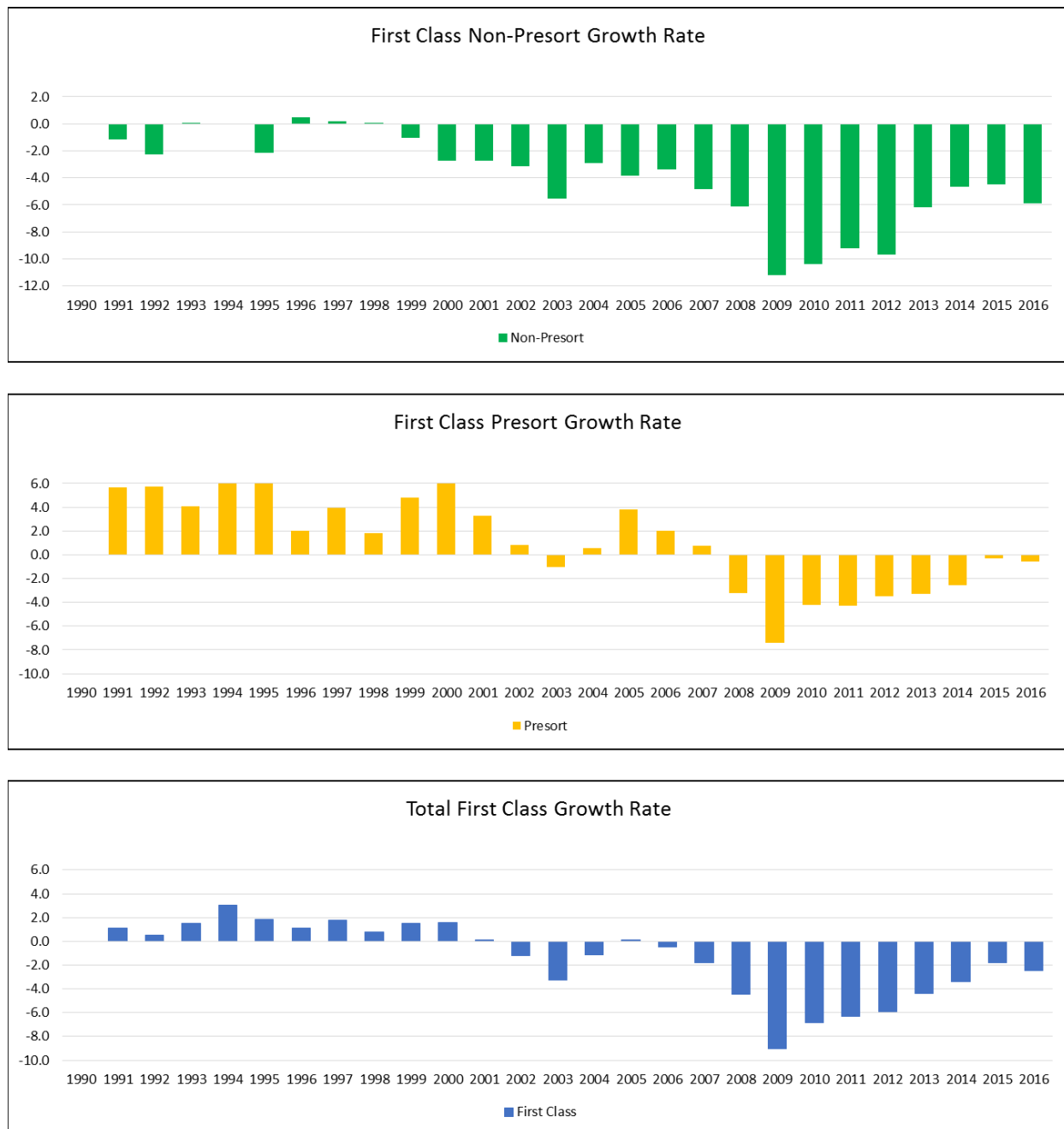


Figure 66: First Class Mail Growth Rates – Presort versus Non-Presort



C. Standard Mail: Carrier Preparation versus Sort Preparation Indexes

Standard Mail can also be segmented into two categories: Carrier Preparation and Sort Preparation. Carrier preparation are those categories where presorting and preparation is at the carrier level, avoiding all of the sorting until the mail reaches that carrier route level. Sort preparation consists of the categories where sorting is necessary to get the mail to the carrier route level.

The following figures show the results of this segmentation. The mail volume in pieces is shown along with the mail quantity from the index aggregation process. In 2008, the classification changes reflected in the TFP data elements allowed weighted mail aspect to enter into the results at the Carrier and Sort category level.

The analysis shows that the growth in Standard Mail has been in the Sort Preparation segment. This would lead to a large impact on the Clerk / Mailhandler labor component. The Standard Mail volume since 2012 has stayed at 80 million pieces, while the Quantity used in the Weighted Mail Volume calculation declined, but then began rising again. This shows the impact of the changes its share of the Attributable Cost between the two segments.

The large drop in 2008 was also partially associated with changes in the catalog rates that year that caused mailers to reduce volumes.

The relationship between the Weighted Mail Volume Indexes is shown with the key Labor Classification indexes in Figure 75.

Figure 67: Standard Mail – Carrier Preparation & Sort Preparation Indexes

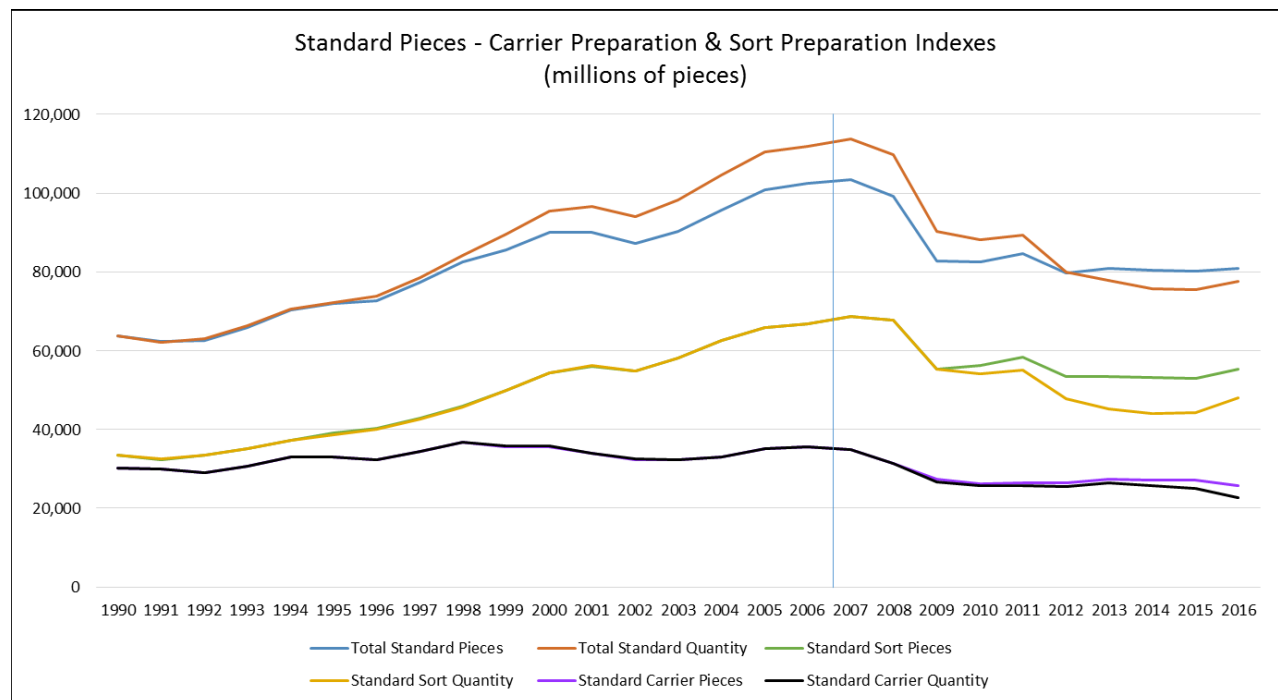


Figure 68: Standard Mail – Carrier Preparation & Sort Preparation Indexes

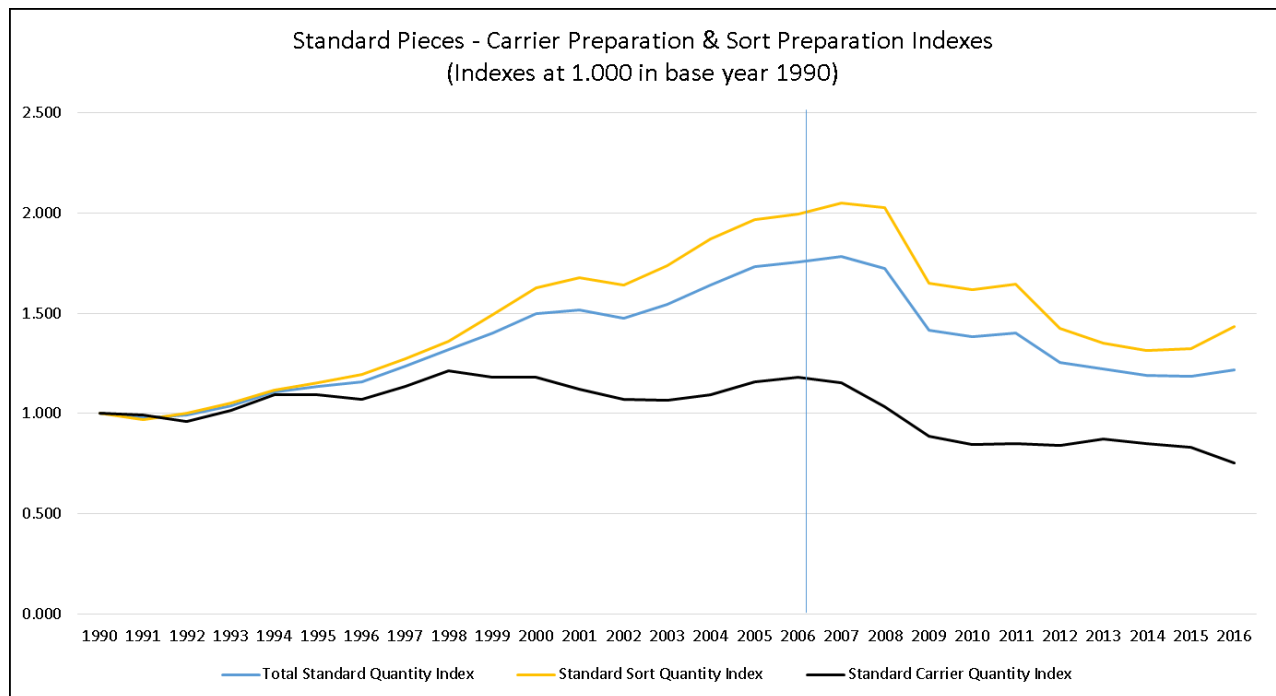


Figure 69: Standard Mail Growth Rates



D. Packages

The term “Broad Package Category” is used here to group together the mail products and classes that could be considered in the package category. The TFP methodology treats the Pieces as equaling the Quantity for these categories. Figure 70 shows the aggregation of the piece volumes for these products. It includes the following mail products and classes:

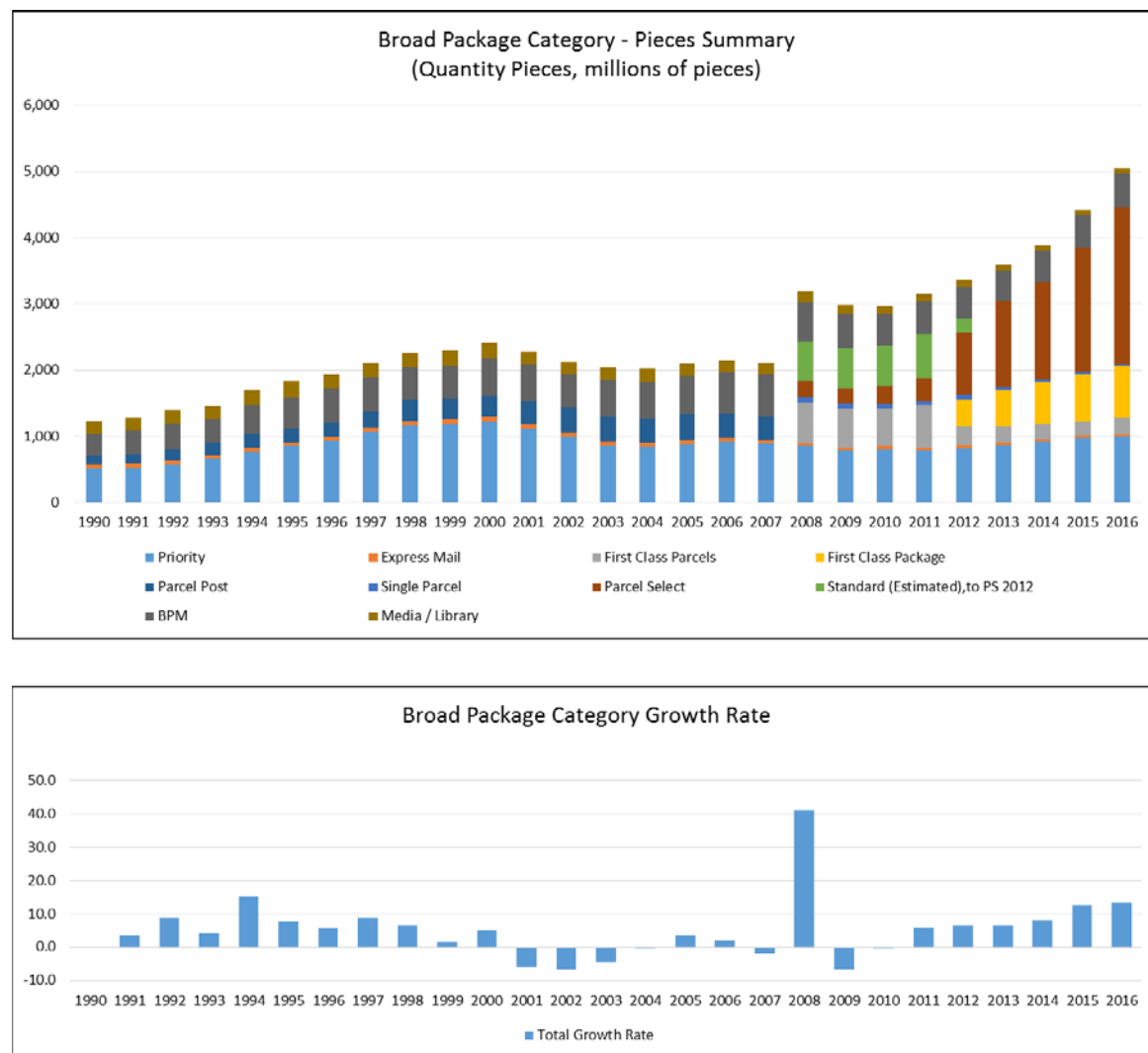
- Priority Mail
- Express Mail

- First Class Parcels
- First Class Packages (new in 2012, split from First Class Parcels)
- Single Parcels
- Parcel Select
- Standard packages
- Bound Printed Matter
- Media Mail / Library

This consolidation of the volumes into a single graph is intended to tie together the different data elements that would define the Exogenous Factor of eCommerce (i.e., package volume growth).

The Weighted Mail Volume calculation does give credit to the growth of parcels. In particular, the growth of Parcel Select in both pieces and share of Attributable Cost is observable in the data calculation elements in the NWPC TFP Model. This can be seen in the growth tables shown in Figure 57 where the Piece Volume growth is negative yet Weighted Mail Volume growth is positive for 2015 and 2016.

Figure 70: Package Volume – Broad Category Definition



5. Creation of an Operations Index

The Aggregate Input Index is based on the Labor, Materials, and Capital. There are two primary results indicators – Total Factor Productivity and the Labor Productivity Index. A new Operations oriented index can be created using the appropriate components of Labor and Materials.

In Labor, there are two basic groups: Operations and Indirect. The Operations segment is defined as Clerks / Mail Handlers, City Carriers / Vehicle Service Drivers, and Rural Carriers classifications. The remaining labor classification groups are considered the Indirect segment Maintenance Service and Vehicle Service could actually be considered in either segment. They were put in Indirect for this analysis.

In Materials, the Transportation and Not-Transportation segments were presented in an earlier section. Transportation represents over half of the Material category. It is directly related to Operations.

The two segments Operations Labor and Transportation Materials are combined into an aggregated sub-index for analysis. These results are shown in the following figures.

Figure 71: Labor Index – Operations versus Index Classification Groups

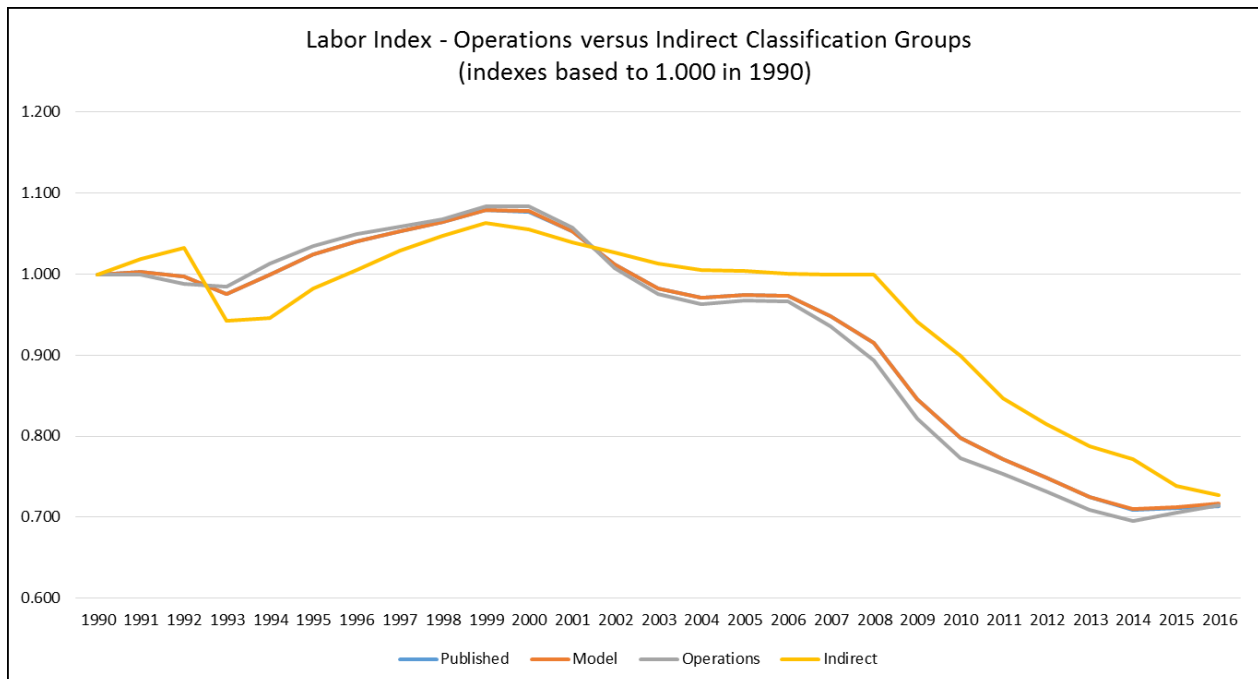
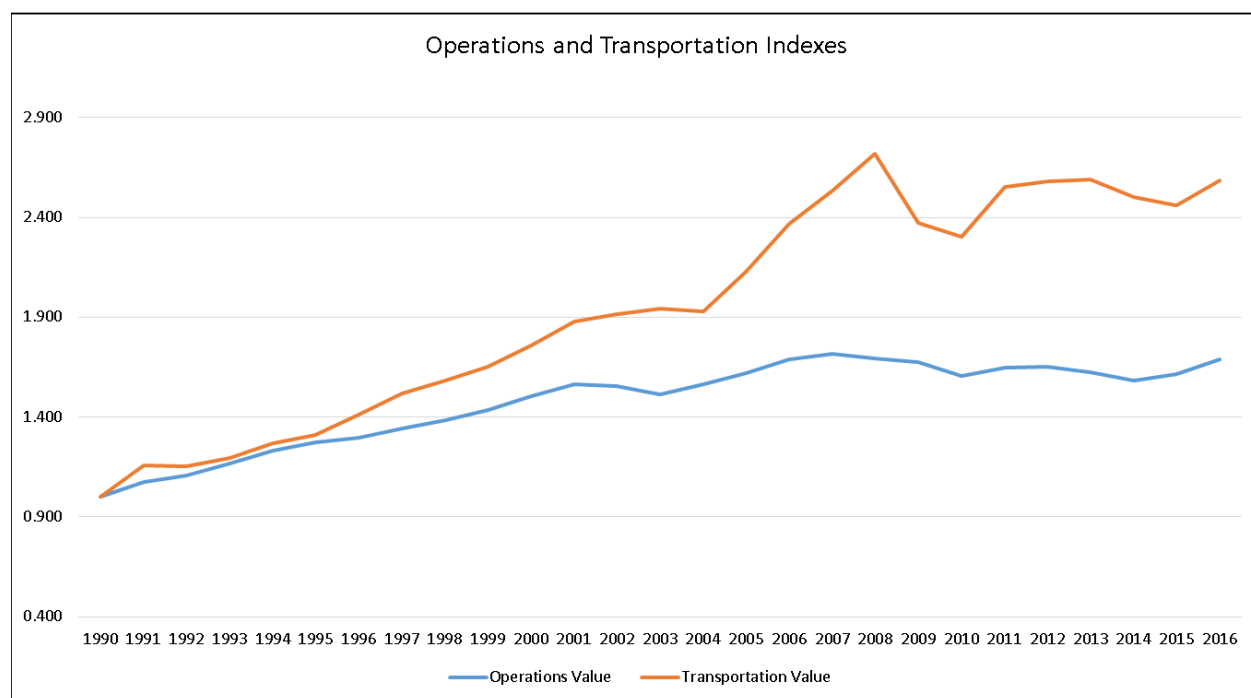
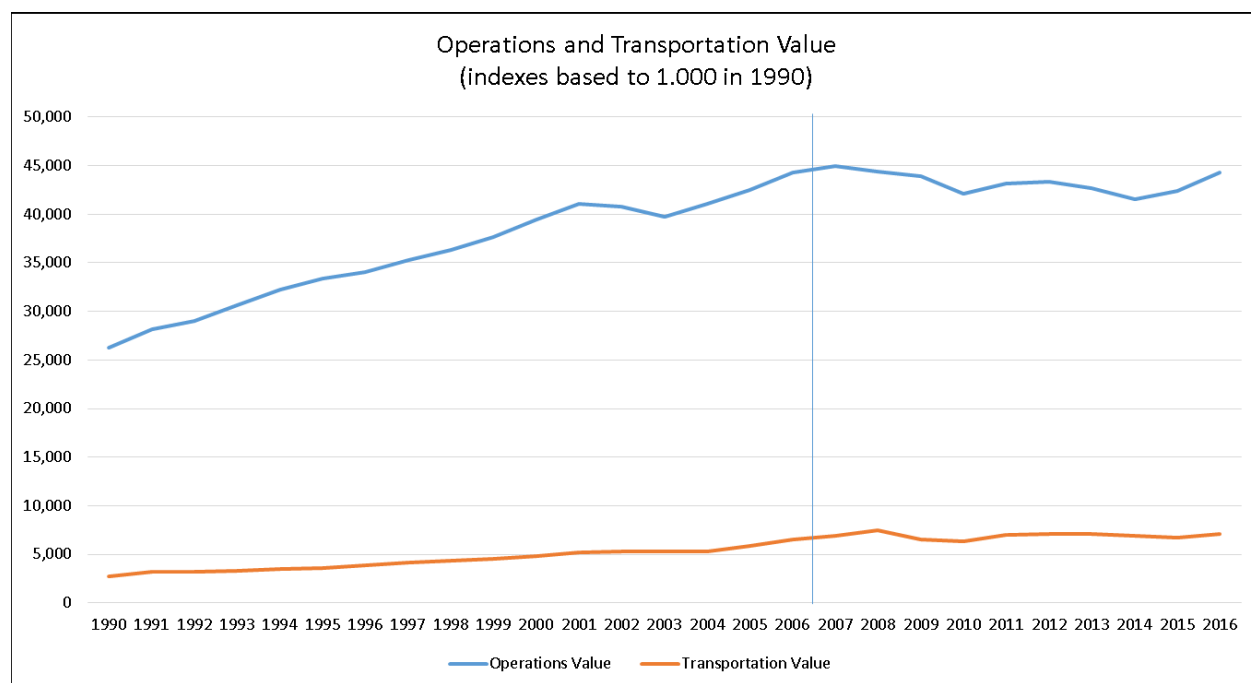


Figure 72: Operations Labor and Transportation Materials Indexes



The relative value of the Operations, Labor and Transportation Material is put into perspective in the figure above. Operations has been in the \$40 to \$45 billion range in the After PAEA period, while Transportation has been in the \$7 billion range. When combined, the changes in the aggregated index follow the operations labor component due to the relative size of the two indexes.

The Transportation index does show the spike in the past two years as previously identified. In the context of total productivity, it did not cause a large increase in the aggregated result.

Figure 73: Growth Rates for Operations Labor & Transportation Indexes

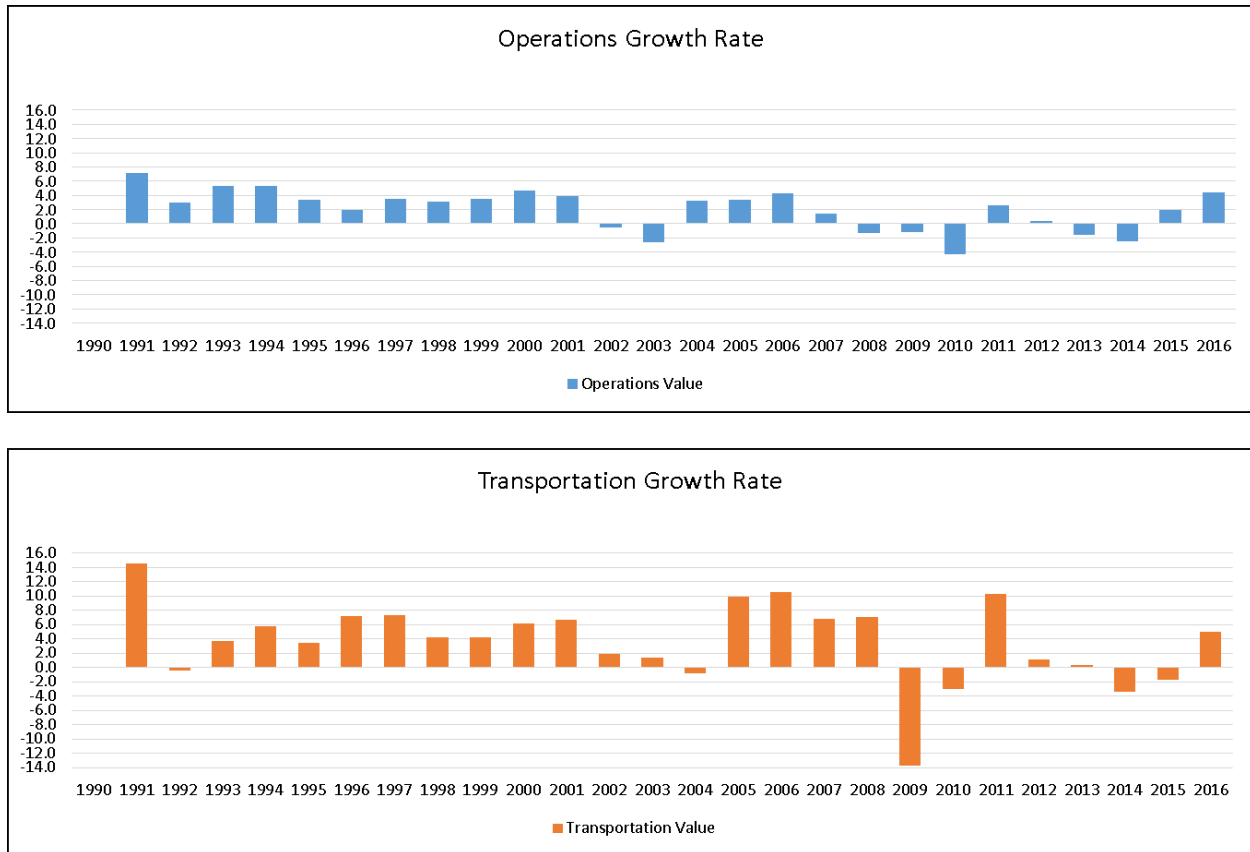
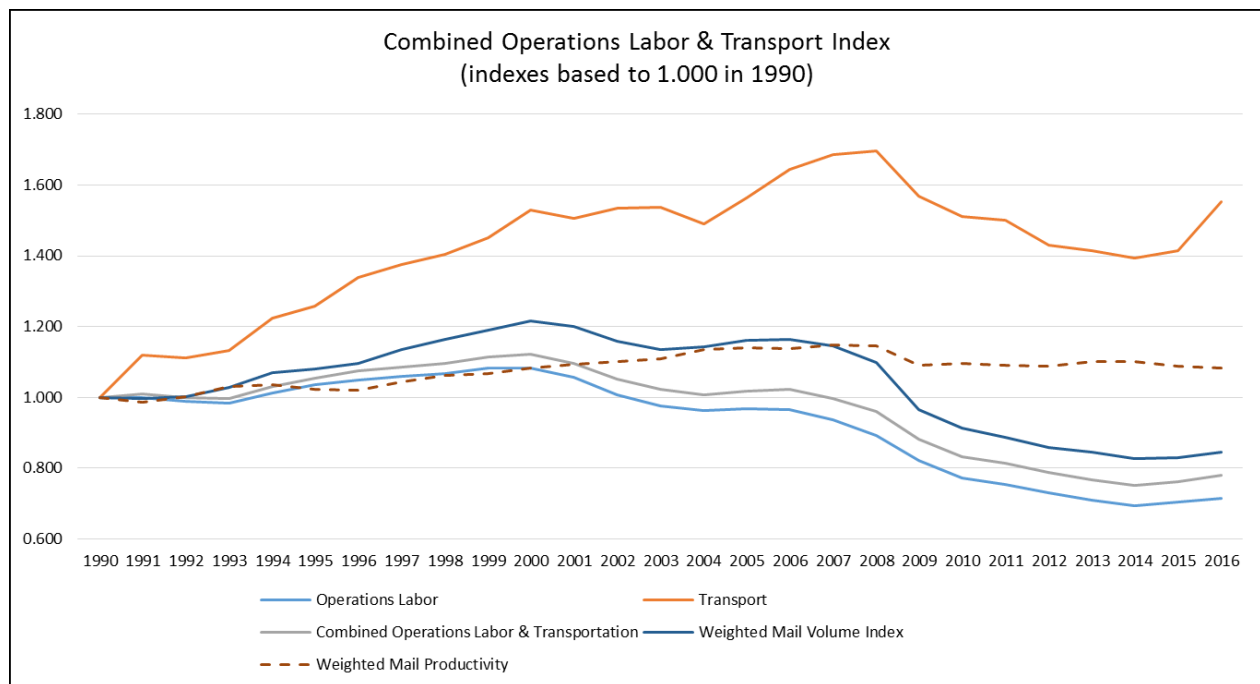


Figure 74: Combined Operations Labor & Transportation Indexes

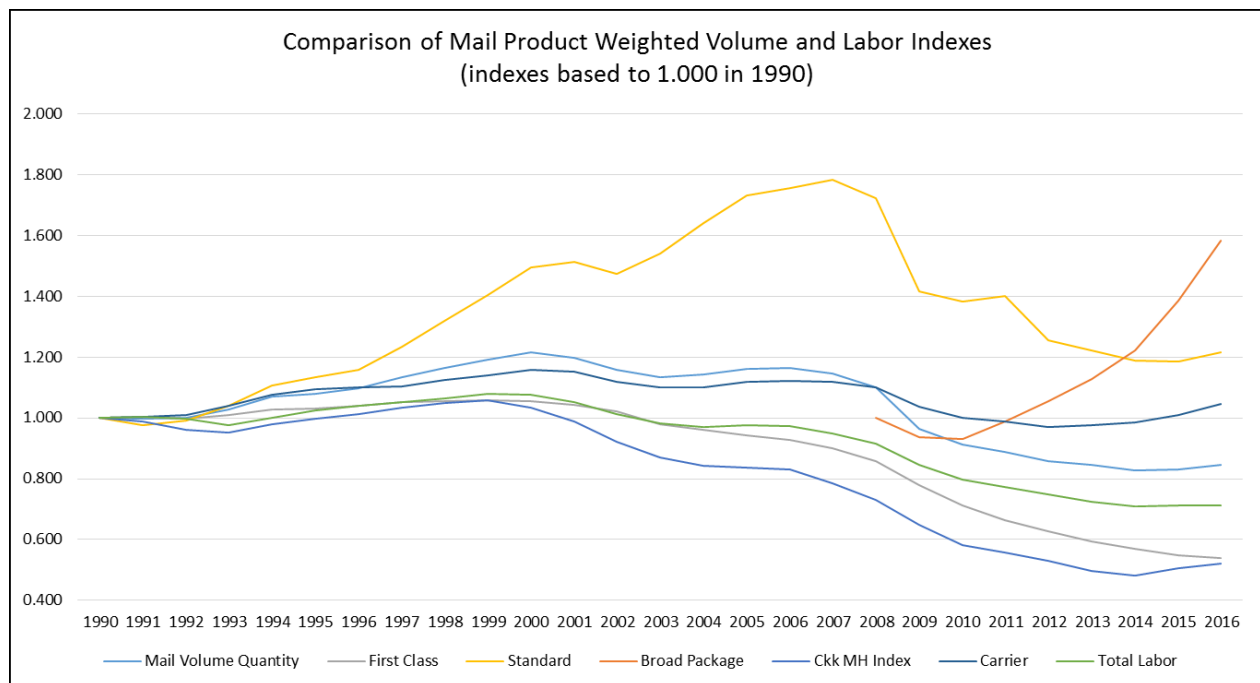


- Transportation is displayed using the orange line.
 - It showed considerable growth from 1990 until the recession in 2008.
 - Transportation showed a considerable decline from 2008-2014.
 - There has been an uptick since 2014 reflecting service efforts.
- Operations labor is shown in the lighter blue line.
 - It grew slightly in the 1990's.
 - The combination of automation efforts and the decline in weighted mail volume resulting in declines in operations labor through 2014.
 - Operations Labor reflected the uptick in weighted mail volume from 2014 to 2016.
- The combined Operations Labor and Transportation index is displayed with the gray line.
 - It tracks the Operations Labor index closely.
 - However, the higher growth rate of Transportation in the 1990's pushes combined index slightly higher than the Operations Labor index.

6. Comparison of Mail Product Volume to Key Labor Indexes

Figure 75 shows a combination of Labor and key weighted mail volume indexes. This graph is intended to show a comparison of the main Labor Indexes next to the main mail volume indexes. Since all are set to one in the base year of 1990, it provides a comparison of the trends of the related metrics.

Figure 75: Comparison of Key Mail Product and Labor Indexes



There are a couple of basic “takeaways” from this graph.

- Many of the weighted mail categories showed flat or low growth in the 1990's followed by declines until 2014.
- Standard Mail weighted mail volume continued to grow until 2007 before it declined. Standard Mail has been stable since 2012.
- The broad parcel category grew substantially from roughly 1.0 in 2008 to 1.6 in 2016.
- The trend line in First Class Mail with the declines of from electronic diversion is followed by a similar pattern in Clerk / Mailhandler labor index.
- The Carrier Labor index line does not show the range of decline of Clerk / Mailhandlers. It does show the reductions starting in 2000 as DPS matures and route optimization efforts begin.
- The broad package volume index is shown starting in 2009 due to definitional changes in the TFP database. It does show that volume in the broad package category have gone from 1.00 in the base year of 2009 to just below 1.6 in 2016. The package volume has increased approximately 60% over this period, primarily in DDU Parcel Select. During this period the Carrier labor index slowly declined then leveled out. This is in part the effect of the non-career employee increase.

V. Measuring Postal Service Efficiency

This section will bring together the findings of Report 1 and Report 2. First, the analysis of productivity for the Before and After PAEA periods will be summarized. Finally, the conclusions covering both reports will be addressed through a set of questions.

1. Summary of Productivity - Before and After PAEA

This report has provided a significant level of detailed analysis of productivity performance, framed into the two time periods. This productivity can be summarized as follows:

1. As measured by TFP, the Postal Service's productivity was slightly lower on an average annual basis in the After PAEA period. The Before and After periods can be segmented into six groups of years. The key results are summarized in Figure 76.

Figure 76: Summary of TFP Process – Annual Growth Rates

Summary of TFP Process - Annual Growth Rates								
TFP Metric	Before PAEA			After PAEA			Before	After
	1990	1993	2001	2007	2010	2014	1990	2007
	1992	2000	2006	2009	2013	2016	2006	2016
Total Factor Productivity	0.52	0.34	1.33	0.05	1.54	0.04	0.72	0.64
Labor Productivity	1.43	1.23	1.83	0.80	1.92	0.71	1.48	1.22
Postal Inflation Index	4.80	2.03	1.91	4.14	1.46	0.07	2.48	1.85
Network (PDs) Productivity	0.68	-0.44	2.62	5.05	4.10	0.67	0.84	3.35
Total Output Productivity	0.48	0.59	0.77	-2.09	0.45	-0.22	0.63	-0.51
Workload	1.23	2.19	0.13	-3.87	-1.94	0.19	1.30	-1.88
Total Output	1.19	2.45	-0.42	-6.01	-3.03	-0.06	1.21	-3.03
Weighted Mail Volume	1.20	2.50	-0.66	-6.51	-3.21	0.20	1.15	-3.18
Miscellaneous Output	1.01	1.37	3.50	0.17	-1.07	-3.89	2.06	-1.54
Network (Possible Deliveries)	1.39	1.42	1.43	1.13	0.61	0.82	1.42	0.83
Input Total	0.71	1.86	-1.20	-3.92	-3.48	0.15	0.58	-2.52
Labor	-0.19	0.97	-1.70	-4.67	-3.86	-0.52	-0.18	-3.10
Materials - Transportation	5.27	3.99	1.22	-1.57	-2.58	3.10	3.24	-0.58
Materials - Non-Transportation	6.44	5.64	-2.35	-3.92	-1.79	3.64	2.96	-0.80
Capital	5.42	6.07	3.60	2.71	-2.51	-1.33	5.08	-0.59

2. TFP is based on a composite Workload measure that combines Weighted Mail Volume, Miscellaneous Output, and Possible Deliveries. The fundamental weighting relationship between these was constant Before PAEA. The After PAEA period started with the exogenous factor of the Great Recession and a historic drop in mail volume. This changed the fundamental relationship used in the weighting between the Workload components.

This increased the impact of Possible Delivery growth on the net TFP result. The gap between Network (Possible Delivery) Productivity and Total Output (effectively volume) Productivity became much greater as a result of the volume drop of the Recession and electronic diversion.

3. The Postal Service closely matched Input (Resources of Labor, Materials, and Capital) to the Total Output (Weighted Mail Volume and Miscellaneous Output) after the large volume drop of the Great Recession. This is particularly commendable as positive weighted volume growth did not return until 2015.
4. The TFP methodology does reflect productivity impacts associated with Underlying, Exogenous, and Pricing Factors:
 - a. The substitution of higher cost career hours with lower cost non-career hours is reflected in the Labor input index.
 - b. The impact of electronic diversion of First Class Mail volume loss and the relationship between Presort and Non-Presort is reflected in the Weighted Mail Volume index.
 - c. The impact of eCommerce on package growth is reflected in the Weighted Mail Volume Index, leading to an increase in growth in 2015 and 2016 while total piece volume growth is negative.
 - d. The impact of increase Transportation and other Materials cost changes are reflected in the Input index.

2. Conclusions – Measuring Postal Service Efficiency

The analysis of the productivity performance of the Postal Service in the Before PAEA and After PAEA periods has been presented using the TFP methodology framework. Report 1 reviewed and documented the TFP methodology. NWPC created a TFP model to facilitate the analysis of the Before and After periods. The conclusions from the detailed analysis result of this report will be framed through the following questions:

- A. Is TFP Accurate & Appropriate?
- B. Did the Price Cap improve Postal Service effectiveness?
- C. Is the Postal Service efficient?
- D. Is the Postal Service more efficient After PAEA?

A. Productivity Measurement – Is TFP Accurate & Appropriate?

The first part of this question is if TFP accurately measures Postal Service productivity. The conclusion of these reports is that TFP is an accurate measure of Postal Service productivity. This conclusion is based on the following:

1. TFP includes all aspects of resources and work content in the components. These are applied in an objective, consistent methodology.
2. The key factors that impact productivity are reflected in the methodology. These include the following aspects of productivity:
 - a. Mail volume is weighted for work content based on the changes in piece volume and the share of Attributed Cost based on ACR data. For example, the recent shift in Parcel Select and the associated work content is reflected in the resulting Weighted Mail Volume Index.
 - b. Changes in the work content though mail classification (e.g., presort, drop-shipping) are reflected in the Weighted Mail Volume Index.
 - c. The Labor input reflects the shifts in employee categories and wage rates. The shift from higher cost career employees to lower cost non-career employees is reflected in the results of the Aggregate Labor Index.
3. Materials, which include transportation costs, are reflected in the productivity measurement.
4. Capital is included, but has a small impact on the TFP result due to its relative contribution as compared to Labor and Materials.
5. The TFP methodology has been adjusted consistently over the years by Christensen Associates as data systems, mail classifications, labor classifications, and other factors have changed.

The second part of this question is if TFP is an appropriate measurement of Postal Service productivity. The conclusion of these reports is that it is an appropriate measurement, with the following qualifications:

1. The only aspect that concerns both accuracy and appropriateness with TFP concerns how the weighting between mail volume and possible deliveries is applied to create the composite workload index. This only becomes an issue when the historical relationship between volume and deliveries changed dramatically when volume dropped starting in 2008 with the Great Recession. The aspect of accuracy is more about the timing and process to adjust the weighting in reaction to the changing relationship, rather than the result is not accurate.

The use of a combination of volume and deliveries into a single workload metric is appropriate. Unfortunately, there is no objective “right” answer for what the weighting should be between volume and deliveries. It is clear that a combined metric is a more accurate measure of productivity than just volume or deliveries alone. An alternative methodology using a CRA based approach is defined in Appendix 4. This approach is uses a weighting factor that is adjusted annually and entirely based on CRA data. This approach might be more appropriate than the current backward looking, fixed weighting methodology.

2. TFP is an appropriate measure because it does include all aspects of Postal Service resources and work content. This report demonstrates that the TFP methodology can be used to examine the relationship of Underlying, Exogenous, and Pricing Factors with Postal Service productivity.
3. TFP is also appropriate in that the methodology could provide substantial analytical information beyond the TFP productivity result. The Labor Productivity Index and the Postal Inflation Index are also accurate and appropriate measurements of different views of productivity. The components that make up these measurements also provide useful analytical measurements of labor, materials, capital, mail volume, and miscellaneous services that could be used in management processes.

B. Did the Price Cap Improve Postal Service Effectiveness?

The impact of the Price Cap is difficult to directly attribute to specific TFP productivity results, in total or in specific components. The analysis in this report was able to indirectly relate the Underlying, Exogenous, and Pricing factors to aspects of the TFP components and results. Instead of relating the Price Cap to productivity, this question is about effectiveness. By effectiveness, this is the assessment aspect of the productivity performance. In this context, the Price Cap did appear to have indirect influence on the Underlying Factors and the control of resources to match work content.

In the After PAEA period, the TFP productivity did increase. This can be attributed to the combination of the volume and the possible deliveries in defining the TFP measurement. When using only Total Output (which is primarily Weighted Mail Volume), productivity in the After PAEA period was flat since 2010, after the initial large volume drop. The Postal Service was very effective in closely matching Resources to the Total Output since 2010. This matching of resources can be indirectly attributed to cost management strategies, including ones that traded service downgrades for cost savings.

The Price Cap appeared to have an influence on the negotiations in the labor contracts. The ability gained in replacing career employees with non-career employees might not have happened without the Price Cap constraint limiting the potential range of outcomes.

The productivity results of the After PAEA period do appear to have been influenced by the Price Cap, with an increased result of effectively matching resources to the declining mail volume. It is challenging to maintain productivity in a declining volume environment.

C. Is the Postal Service efficient?

The question if the Postal Service efficient is often asked by mailers and other stakeholders. Productivity, as measured by TFP, provides a measurement of efficiency. If the Postal Service was not efficient, there would likely be more variation between resources used compared to the work content. TFP and its components demonstrate that control of resources does relate to the Workload. Even with the volume drop at the Great Recession, the Postal Service quickly took actions to match resources to the new lower mail volumes. Also, the fact that postal Inflation closely tracks CPI-U suggests the Postal Service control of costs is similar to that of the general economy.

Reaction by the Postal Service to the Exogenous Factors of electronic diversion, eCommerce, and economic impacts can be seen directly and indirectly in the components of TFP. This report showed how the TFP data could be segmented to isolate some of these reactions. It is also clear that the Underlying factors, in particular automation, led to a more efficient Postal Service. The high growth in TFP in started 1999, as the automation program matured and led to savings capture as seen in the reductions in Clerk / Mailhandler and Carrier hours.

In the After PAEA period, the opportunity to replace Labor with automation (capital) in operations is limited. Most of the letter and flat processing is already automated and improving on-street delivery efficiencies is challenging where automation is less likely to be a source of improvement. The opportunities in productivity improvement through the actions encompassing the Underlying Factors in the After Period was centered on mail processing facility consolidation, delivery optimization, and process improvements (e.g., the Lean Six Sigma program). These programs are all focused on improving efficiency and managing costs.

D. Is the Postal Service more efficient After PAEA?

The conclusion of Northwest Postal Consulting is that generally, the Postal Service became more efficient in the After PAEA period. The results of the different productivity metrics are presented in Figure 76: Summary of TFP Process – Annual Growth Rates. TFP increased at about the same rate as in the Before PAEA period. Total Output productivity went down over the entire period, with a sharp drop during the Great Recession followed by flat performance since 2010. The TFP results show that the Postal Service effectively matched the Input to the Total Output after the Recession in a declining volume and growing delivery network environment.

However, the focus on aggressively managing costs did have an impact on service. The Service Standard Realignment first reduced Overnight First Class Mail coverage, then eliminated it almost entirely. The service performance did not generally meet goals after the change, leading to the suspension of the Network Consolidation program and additional resources to improve service performance.

E. Summary

These two reports first provided a thorough analysis of the TFP methodology, then applied the results and components of TFP to the analysis of the Before and After PAEA productivity performance. The Underlying, Exogenous, and Pricing Factors were identified and applied in the analysis of productivity performance.

TFP is a widely accepted as a measure of overall productivity in the Postal Service. Yet it is not understood beyond a conceptual level. The use of TFP is limited to a couple of paragraphs in the Annual Report to Congress. These reports have shown that TFP could provide a useful and effective role in the evaluation and management of productivity performance for the Postal Service.

VI. Appendix Listing

The following are provided as Appendix to this report.

Appendix 1 Consolidated TFP Data Set – 2016 Final

Appendix 2 Single Year Example

Appendix 3 TFP Methodology – Reference Documents

Appendix 4 Alternative Methodology for the Workload Weighting Factor

Appendix 5 NWPC TFP Model – Version 2 (Excel File)

Appendix 6 Graphs Used in Reports 1 & 2 (Excel File)